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A NEW APPROACH TO THE PRICING OF MAJOR WEAPONS SYSTEMS

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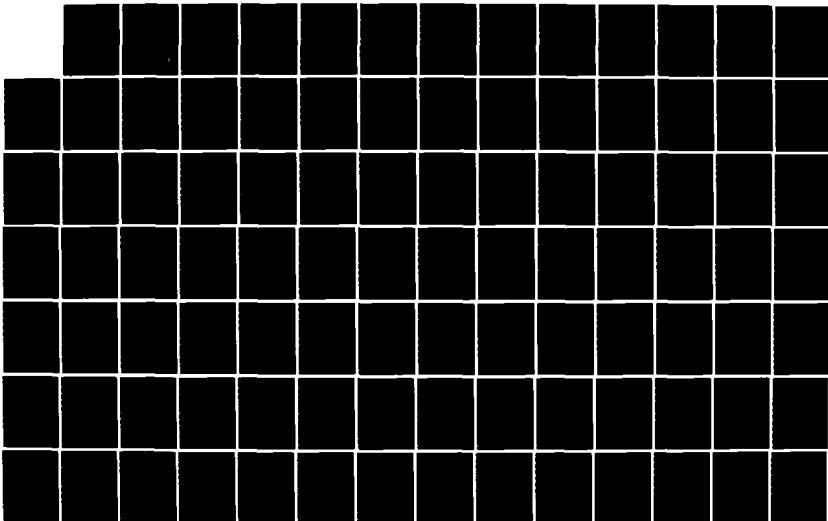
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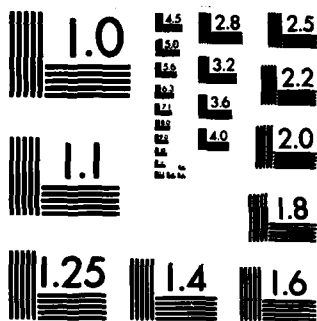
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A NEW APPROACH TO THE PRICING OF MAJOR WEAPONS SYSTEMS

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<p>This report explores the potential for developing new approaches for the pricing of major weapon systems which may motivate contractors to invest in productivity-enhancing technologies and capital equipment.</p> <p>The report concludes that there is no modification to a pricing format which in an of itself will motivate capital expenditures other than the direct payment of these expenses by the government. The complexity of the capital budgeting decision is discussed as is the motivation for making or postponing investments in new technologies or capital equipment. A review of the post-<u>Profit '76</u> literature is included in those sections detailing</p> <p><i>add single quotes here</i></p>				
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the inability of increased profits to stimulate investments and the deviation between the DOD's perception of factors which motivate industry behavior and industry's view of these motivating factors. A

A brief but important section is devoted to the problem of basing profits on underlying cost. The report points out that there is no market-based mechanism for establishing profits on negotiated contracts that does not depend on an administrative judgement and decision.

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Table of Contents

	<u>Page</u>
I. PURPOSE	I-1
II. EXECUTIVE SUMMARY	
Discussion	II-1
Summary	II-8
III. LITERATURE ANALYSIS	
1. DOD & the Behavior of the Aerospace Industry	III-1
2. Internal and External Variables	III-4
3. External Variables	III-6
4. Other DOD Policies Aimed at Improving Contractor Profitability and Capital Investment Not Necessarily Related to Profit '76	III-15
5. Contract Incentives/Contract Type	III-21
6. Techmod	III-29
7. External Variables: Non-DOD	III-32
8. Internal Variables	III-36
IV. CAPITAL INVESTMENT AND PRODUCTIVITY	IV-1
1. Conventional Wisdom	IV-1
2. The Enterprise View	IV-4
3. Pricing Policy, Efficiency and Related Matters	IV-8
V. THE THEORY OF ALTERNATE APPROACHES	V-1
1. Introduction	V-1
2. Economic Theories	V-4
3. Discussion	V-9

Table of Contents

VI. THE APPLICATION OF ALTERNATIVE APPROACHES	VI-1
1. The Appropriate Application of Theory	VI-4
2. The Entry/Exit Problem	VI-6
3. The Ideal Acquisition System	VI-7
4. Foreign Buyers of U.S. Military Goods and Services	VI-8
5. Buy "Commercial" Versus the Foreign Military Sales Approach	VI-9
6. Producing and Non-Producing Nations	VI-10
7. Welfare Economics	VI-13
8. The Use of Marginal Cost in Pricing	VI-15
9. The Full Cost Thesis	VI-19
VII. MARKETING CONSIDERATIONS, CORPORATE STRATEGY AND THE PRICE, PROFIT, INVESTMENT CONTINUUM	VII-1
1. Introduction	VII-1
2. Market Responses	VII-5
3. Market Stability and Market Power: Regulatory Concepts	VII-7
4. Business Base Planning	VII-11
5. Welfare Economics Revisited	VII-15
6. Business Base Planning Risks	VII-16
7. Regulation	VII-17
8. Unlinking Profits From Cost	VII-18
9. General Discussion on the Business Base Planning Approach	VII-19
10. Summary	VII-21
VIII. SCHEMATIC REPRESENTATIONS	SR-1
IX. GLOSSARY OF TERMS	G-1
X. BIBLIOGRAPHY	B-1

PURPOSE

During the past decade there has been growing concern over the ever-increasing cost of the development and production of weapons systems for our armed forces. This concern has been further complicated by the perception that the defense industrial base is eroding and that its productivity is deteriorating.

The Department of Defense (DOD) has conducted numerous studies, reviews and investigations in an attempt to identify the root causes for these spiralling costs and their associated problems. As a result of their findings, the DOD has implemented a variety of policies aimed primarily at incentivizing defense contractors to make facilities investments which are to serve to reduce program costs by boosting productivity. Indications to date are that the success of these efforts has been limited and spotty.

There is a growing belief within the acquisition community that one of the stumbling blocks has been DOD's current pricing procedures which base profits on reimburseable costs. The feeling is that this practice creates a disincentive whereby contractors perceive little value in controlling costs and improving productivity through new capital investments. This is one of the problem areas that this study addresses.

In short, the purpose of this project is to develop a new approach to pricing major weapon systems which can detach costs from profits perhaps in such a way as to encourage defense contractors to improve productivity and effect a net reduction in total weapon systems costs.

CHAPTER II
EXECUTIVE SUMMARY

Discussion

Preparing an executive summary for a report of this type is difficult primarily because the findings and conclusions are somewhat contentious.

- First, the report concludes that major weapon systems are bought in an economic environment best described by welfare (regulatory) theory and not conventional price theory. This conclusion is based on the following:
 - The product monopoly enjoyed by most prime contractors once full scale production begins.
 - The welfare-oriented economic techniques used to establish profit rates.
 - The many redistributive goals built into the acquisition system, e.g., allowing for less than efficient plant utilization rates; the ultimate allocation of defense dollars by regions; and the maintenance of employment for certain types of skills, etc. Actions such as these are not in consonance with conventional price theory, the ultimate goal of which is economic efficiency and not economic "fairness".
 - The average full cost concepts that underly the price setting process, once again an artifact of welfare as opposed to price theory.

- Second, based on the above, the report concludes that welfare-based regulation is essential if the project's two goals are to be attained: (a) that of basing profits on something other than costs and (b) motivating contractors to invest in productivity improving capital equipment and technologies.
- Profits: Of the two goals, the profit issue is the easier to solve. Because of the absence of sealed bid, fixed-price competition, profits must be determined administratively. Two profit-setting measures are then available; a profit based on invested capital; a profit based on assets used. Using these measures proactively to establish profit is a direct adaptation of welfare theory. There are no alternatives to an administrative procedure when free market conditions cannot do the job.
- Capital Investments: The investment issue is far more difficult to solve except as the government elects to directly provide the funds needed to facilitate a contractor's plant or coerces the contractor into doing so. This difficulty is easily explained; there is no legal basis for the government to force a firm to invest in capital equipment. The decision to invest rests solely with the contractor. The contractor will not make investments except as a number of complex factors

come together simultaneously. Most of these factors are beyond the control or influence of the DOD. Because of this, a "regulatory approach" is essential where there is a proven need to gain measurable productivity improvements in the various defense industries.

Unhappily, the report concludes that the marketplace for major weapon systems is not a free market in which competition generates the best price possible while motivating contractors to look for a significant production-oriented edge over their competitors. Rather, the defense industries operate much as a public utility might with the consumer; in the final analysis, the public pretty much pays the price demanded by the monopolist.

In this regard we feel that the use of terms such as "monopsony" and "bilateral-monopoly" are technically correct but factually misleading. The government is a monopsony vis-a-vis the defense industries only in the strict definitional sense that it is the sole buyer of this industry's output. But it can exert its power only by refusing to buy. Once it decides to buy, the real economic power shifts to the producer. Given the necessary organization of the acquisition process, a product monopoly is ceded to the contractor for however long the government elects to buy that product. In bilateral monopoly theory the buyer and seller should share power. In practical terms they do not.

In many regards, the shift of economic power to the seller is based on the politics and not the economics of the acquisition process. A political consensus is essential for a major weapon

system to move into full scale production. In an Alice in Wonderland type of scenario, that consensus then serves to protect the monopoly power of the seller despite the fact that virtually all of the members of the consensus are elected, appointed or commissioned government officials. By staking their careers, in part or in whole, on a specific acquisition they become an important political support element for the contractor who is then able to exact an economic bribe: in general, sufficient funds to pursue a desired corporate strategy.

Because of the many political, social, economic as well as military goals of the systems acquisition process, there is no way out of this bind except as a specific cost-cutting regime is required of the contractor prior to the essential grant to him of a product monopoly. The cost-cutting regime that we are suggesting is consistent with manufacturing life cycle realities. Overhead and supervisory costs per unit of output should decrease as various production and support functions become routine. These savings in costs should be predicted, planned for, and implemented with the unit price to the government gradually decreasing.

These savings cannot be realized, however, if contracts are let on an annual basis because this process leaves a contractor with far too many business unknowns. The only way to eliminate these unknowns is to enter into a multi-year contract that allows for his strategic corporate planning to take place in as stable a business environment as possible. Moreover, negotiations with major contractors should not be conducted solely on a contract by

contract basis but instead be based on an on-going process in which the effect on contract costs of changes in the business base of a firm is actively considered. As the business base of a firm is modified by the award of new contracts and the completion of old ones, appropriate changes to the costs to be paid by the government for overhead and other non-production line costs should be recalculated and factored into the negotiations process for a new contract. Where the business base of a firm is expanding, appropriate reductions in unit overhead costs should be required. Conversely, where the business base is diminishing, upward adjustments in these costs may also be required. In either case it is critical that full recognition should be given to the effect on unit cost changes in a firm's sales position and the need for enforcing a policy which does not automatically and unitarily link the level of overhead costs per unit of output to the production line costs incurred in the manufacture or assembly of that product. The requirement to attain economies of scale, i.e., the spreading of relatively fixed costs over an increased output needs to be built into the negotiating process as it has not, heretofore, been done. To do this, a contract cannot be negotiated as an isolated event but in conjunction with a review of the entire contractual base of that firm. By linking this process to "business unknowns" reducing multi-year contracting process, contractors should be motivated to control their costs, specifically to reduce their risk minimizing capital-like investments in a broader base of technological skills and personnel than is otherwise needed in a stable business environment.

Stockpiling relatively non-productive technically oriented personnel does not, in our opinion, add significantly to our defense industrial capabilities. These people could better be used in the private sector.

In order to avoid penalizing the contractor for required cost reductions, profits, in turn, should be unlinked from cost and based, ideally, on a return on equity (investment) construct. Ideally, this policy should be standardized to, for example, a 15% post tax return per year based on a sales plan for the firm that is realistic and attainable.

In keeping with welfare practices, corporate stability would be explicitly guaranteed while, consistent with price theory, prices would be based ultimately on some workable notion of marginal costs. Productivity improvements would be planned for with a sufficient portion of the savings generated by these improvements passed back to the government by way of lower prices.

This approach implies a greater intervention in the affairs of the large defense contractor than now obtains. Ideologically, this is an "uncomfortable" position to take in that it challenges the sanctity of private property and an ideological reliance on free market forces.

If the Pentagon's complaints are correct, however, free market forces have not affected the major systems acquisition process substantially. Given the affordability issue and the transcendent need to defend our country, then recourse to regulation is essential. In this regard, "indicative planning" may be

the most appropriate form of planning in that it specifies goals but leaves their attainment to the private sector.

In a sense, all the government would be doing in the proposed regulatory scheme would be to exert its right as buyer by establishing a market clearing price and then allowing its suppliers to manage their costs to this price. Given the product monopoly power of the seller, there does not appear to be any other choice.

In summary then, our conclusions are somewhat "uncomfortable" in that the free market system is not working for major weapon systems and cannot work because of a whole host of systemic factors. "Uncomfortable" because it says that regulation is essential given the country's needs. "Uncomfortable" because it is suggesting a holistic approach to this regulation as opposed to the piecemeal fine tuning that has been attempted these past 10 to 15 years. But, just as allocative fairness is a critical issue in formulating the defense budget, then the issue of distributive fairness must be dealt with openly.

That, we believe, is the central thesis of this report.

Executive Summary

When we began this project, it was with the belief that competitively oriented "free market" techniques could be found that might rationalize the price/profit/continuum in the defense industries, that is to say that free market competition oriented techniques might be found that could separate profits from underlying costs and improve productivity in the defense industries.

Our analysis shows that for major weapons systems these goals are unattainable using free market forces. A regulatory approach is needed.

The need for a regulatory approach follows from the fact that major weapon systems are rarely bought in the "open market." Only rarely can competition be relied upon to rationalize the economics of their procurement. This is because the acquisition process takes place within a hybrid industrial structure in which competition is of a limited value only. As a result of this, setting profits and motivating productivity improvements in the defense industries requires regulatory procedures.

The lack of a free market is to a great degree due to the de facto product monopoly ultimately ceded to the producers of most major weapon systems. It is also due to the fact that defense dollars are required to perform a number of economic, political, and social as well as military goals. The broad purpose assigned to the defense budget along with the need to maintain an industrial base larger than that which can be fully utilized in peacetime results in a hybrid economic structure which is only

partially responsive to market forces but otherwise responsive to redistributive (welfare) goals. Regulation is then required if specific, efficiency-oriented goals are to be attained.

The rationale and forms of this regulation are dealt with in greater detail in the body of the report. Before turning to our summary findings, however, the sole possible decision rule that we were able to derive from our analysis is as follows:

Wherever possible, the pricing procedures for major weapon systems should gradually be forced to rely on marginal costing concepts.

Profits

Of the project's two goals, that of unlinking profits from underlying costs is the more easily attained. However, this requires that profits be established administratively. To accomplish this, a regulatory procedure akin to the profit setting procedures normally found in public utility regulation is or will be required.

Other than the Weighted Guidelines, two methodologies are readily available:

- Basing profits on invested capital (ROI).
- Basing profits on assets used (ROA).

Both approaches are "arbitrary" in that administrative judgments need then be made on what a "fair and reasonable" profit is. As discussed in the body of the report, this requires a regulatory approach similar to that found in welfare economics in which distributive goals are the basis for most economics-

oriented decisions. "Fairness and reasonableness" concepts do not address competitively derived economic efficiency.

Productivity: Encouraging Investment

Motivating contractor investment in cost cutting, productivity enhancing technologies and equipment is a far more difficult task.

Apart from the economics of the investment decision, motivating productivity improvements is difficult if only for the fact that the decision to invest rests solely with the contractor. The government cannot force this decision except as it elects to pay the bill, i.e., assumes the responsibility for a significant portion of the supply-side capital formation process.

Even, however, when the decision to invest has been made, other factors may limit the quantity, quality or timing of these investments. For discussion purposes only, we have termed these "external and internal" factors. Some examples follow.

Internal Factors

The decision to invest in technologies and equipment is a highly complex process that rests on a broad range of assumptions, judgments and intuition, only some of which are related to the acquisition process per se. The state of the capital markets, for example, is a key internal factor that has a major influence on the decision. Capital market conditions, however, are unrelated to the acquisition process and outside of the influence of the DOD. Nonetheless, this is a major factor to

which management must respond. For example, equity funding may not be available, or interest rates may be far too high to justify tying up funds in plant and equipment; a profitable contract or series of contracts notwithstanding. Despite their pervasive influence on the investment decision, factors such as these are simply not responsive to Congressional or DOD policies or procedures.

Similarly, such factors as low utilization rates for existing equipment and the corporate flexibility that derives from being labor vs. capital intensive limit the willingness of management to invest in new equipment, DOD incentives notwithstanding. Here it needs to be recognized that contractors invest funds to maximize their business interests and not those of their customers.

External Factors

External to the acquisition process are such factors as the annual funding process mandated by Congress; the ability of the buying military service to determine the prime's manufacturing plan by specifying "designated" subcontractors, second and even third-tier suppliers; and other DOD policies and actions whose effect is to artificially alter the industrial structure in which weapon systems are manufactured. To the extent that the DOD makes these decisions, and on a rolling basis, the willingness of a contractor to invest in future-oriented technologies and equipment is minimized because of his inability to predict if, how and when these investments may be used. In many cases, the

more powerful prime contractor shifts the responsibility for the capital formation process to lower tier, smaller firms that lack the prime's industrial power.

In sum, motivating contractors to seek productivity enhancing equipment and technologies is a far more complex undertaking than normally contemplated by Congressional and/or DOD actions. Moreover, because of the monopoly power ceded to a prime contractor during the full scale production process, neither normal market forces nor DOD policies can force the investment in these technologies once a contract has been placed. This then gives rise to the need for forms or regulation which build cost cutting actions into the negotiating process, i.e., before the contract is placed.

Regulatory Approaches

Given the above, we believe that regulatory procedures are necessary but that these procedures should be based as much as possible on "free market" concepts. Moreover, they should be directed at the macro-economic level and not be administered or supervised on a contract by contract basis. Last, as suggested by the data set out in Exhibit I, whatever regulatory procedures that may be adopted need be applied to a very limited number of firms only, primarily those 30 to 40 firms who, as "system integrators" are responsible for the production for major weapon systems. It is these firms who drive the economics of the weapon systems acquisition process in that they account for as much as 50% to 60% of the annual procurement budget.

Before turning to a discussion of a proposed regulatory process which we have tentatively termed a "Business Base Planning" Approach, a number of points need to be set out.

- To be effective a regulatory system must have both a "carrot and a stick". The carrot we are suggesting is a multi-year contract. The stick we are suggesting is the need for programmed and attainable reductions in the unit cost of weapon systems consistent with a life cycle manufacturing analysis. This follows from the marginal price decision rule set out earlier in this summary.
- Under this system, price and profit would be negotiated for Year One only of a prime contract for a major weapon system. After Year One, all contracts for the self same system would be bid in advance on a firm fixed-price basis, with profit a non-negotiated residual.
- The regulatory approach, however, would not be on a contract by contract basis but directed at the entire business base of the firm in order to promote, where relevant, prices based on marginal cost principles.
- Consistent with the fact that a very limited number of firms account for the greater bulk of defense procurement dollars, the business base planning for these firms should be related to the FYDP, i.e., economic and

military factors should be reviewed concurrently in order to develop guidelines on the stability of key elements of the defense industrial base. Factors as the sales base of individual firms, employment such levels, overall corporate profitability, the interrelationship between specific elements of the defense industrial base and other relevant industrial and economic matters should be considered and factored into a modified or separate version of the FYDP, in order to promote the industrial goals of the Department of Defense.

- This last process, in our opinion, should be converted to a highly articulated process in which industrial strength and military strength are viewed as coherent elements of our present and projected military posture.

Notwithstanding the above, this analysis is basically concerned with the gradual development of a procedure with roots in conventional economic theory that can help to stimulate desired productivity improvements in the defense industrial base. The procedure that we have suggested would move towards this goal by requiring that a contractor guarantee yearly inflation adjusted reductions in the unit price of a product (weapon system) based on a predetermined reduction in specified overhead and manufacturing costs as his quid pro quo for a multi-year contract. This procedure mirrors the free market concept of pricing

based on marginal as opposed to full cost factors. Moreover, the prime contractor would be required to bid in Year One on a firm fixed-price basis for all follow-on year acquisitions but do so on a unit price basis consistent with the normal manufacturing life cycle of the product in question. The life cycle theory assumes that relevant non-production line support costs can be gradually reduced as a production line matures, allowing for a decrease in price, an increase in profits, or a combination of the two. The Business Base Planning Approach would require that these productivity-enhancing measures be built into the contract as a risk-shifting mechanism.

Here it should be stressed that this is not a contract by contract process. The method starts with an overall view of the business base of a specific firm; the changes in the firm's sales that are expected over a five year planning phase as various programs (both military and commercial) phase in and out, and the effect of these changes on operating characteristics such as sales, profits, personnel requirements, capital investments, capital utilization rates, etc.

The rationale for this and other statements of this type is amplified in the body of the report.

Relevancy

This planning approach is relevant only for those firms who manufacture or assemble major weapon systems (see Exhibit I). Supplies and similar routine equipment are generally bought on an open market where competition prevails. A planning approach is

not necessary for these procurements, but is, instead, applicable to the limited subset of procurements noted above.

It is only for these major programs and contractors that a Business Base Planning process is, in our opinion, essential. As discussed in the body of the report, these firms would be included as part of an "indicative planning" process with the more micro-management oriented techniques now used eliminated. In a very important sense, a less pervasive but hopefully more powerful form of regulation could be substituted for the current forms of regulation that more closely mirrors a free market approach.

EXHIBIT I

Major Procurement Programs, FY 84 (Dollars in Millions)

	<u>Prime Contractor</u>	<u>Congressional Approval 1984</u>	<u>Program(s)</u>
1.	General Dynamics	\$9,027	GLCM, Standard, SN688, F16, Trident M-1
2.	Rockwell	5,628	B1
3.	McDonnell Douglas	5,283	F18, F15, AV8B, KC10
4.	Litton	3,285	CG47
5.	Martin Marietta	2,542	MX, Pershing
6.	Lockheed	2,276	C5N, Trident I, LSD41
7.	Boeing	1,506	C135, B52MOD, ALCM
8.	Hughes	1,203	AH-64
9.	Grumman	971	F14
10.	Raytheon	885	Patriot
11.	FMC	822	Fighting Vehicle System
12.	LTV	532	MLRS
13.	Ford Aerospace	526	Divad
14.	IBM	456	SH60B
15.	United Technologies	<u>437</u>	UH60
	TOTAL	\$35,379	

Sub-Total as a Percentage of Procurement Budget Total	$\frac{34,739}{85,996}$	= 41.1%
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CHAPTER III
LITERATURE ANALYSIS

III. 1. DOD AND THE BEHAVIOR OF THE AEROSPACE INDUSTRY

In response to a growing public concern with the cost of major weapon systems, the DOD has implemented a number of programs designed to bring about productivity improvements in the various defense industries. Based on the literature reviewed as part of this project, it appears that the consensus among acquisition analysts is that these policies have not been effective. The general belief is that the defense industries have not responded to the capital formation incentives provided to them, resulting in a failure to realize potentially available reductions in the costs of major weapon systems. However, we believe that the problem with this consensus is that it was either reached prematurely, or that the positive financial indicators now evident in the aerospace industry were achieved independently of DOD policy. In other words, a paradox has developed which requires an explanation; the profit and investment policies of the DOD are being highly criticized, but the vital signs of the aerospace industry appear to be quite healthy.

This health is evident in that the aerospace industry is investing substantial sums of money in new plant and equipment. The Aerospace Industries Association of America shows capital expenditures for the industry to be as follows: (See Exhibit II)

EXHIBIT II 1/

New Plant & Equipment Expenditures
(In Billions of Current \$)

<u>Year</u>	<u>Aerospace</u>	<u>All Mfrg. Industries</u>
1975	1.68	54.92
1976	1.69	59.95
1977	2.01	69.22
1978	3.22	79.72
1979	5.27	98.68
1980	7.03	115.81
1981	6.43	126.79
1982	6.04	119.68
1983 ^E	5.55	115.90
1975-1983		
Growth Rate	330.42%	211.02

1/ Aerospace Industries Association of
America; Aerospace Facts & Figures
1983/84.

As shown in Exhibit II, capital expenditures in the aerospace industry have increased dramatically since 1975, rising at a much faster rate than for all manufacturing industries. Given the data, it would be difficult to argue that investments in the aerospace industry are lagging.

Second, there is little or no incontrovertible evidence to support allegations of poor productivity in the aerospace sector. Other than the reality that the costs of weapon systems have increased faster than expected, data on aerospace productivity is, at best, nebulous. According to the Bureau of Industrial Economics (BIE), there really have been no steady, discernable trends in productivity. During the period covered by Profit '76, productivity in the aerospace industry was actually improving despite the report's contrary findings concerning the overall defense industrial base. According to the BIE, production worker productivity climbed gradually through 1977, declined during the final two years of the decade, showed a slight gain in 1980, rose sharply in 1981 and declined again in 1982, but has been rising ever since. Although there may have been little increase in productivity over the last decade, there is little evidence that it is declining.

To restate the paradox, the consensus on the DOD incentive policies seems to be that either they have failed entirely, or have fallen far short of their expectations. Yet, the data indicates that the results they were intended to achieve have been partially attained, i.e., rising capital expenditures, improved profitability, and a productivity rate which if not

improving is, at least, not deteriorating. We believe that this paradox can be explained by demonstrating that the direct stimulus-response relationship between DOD policy and the aerospace industry does not exist to the extent that policy makers assume. Through a discussion of the "internal" and "external" variables which surround the capital investment decision, (this distinction will be explained below) it can be shown that the aerospace industry's behavior is substantially independent of the DOD. That is, while DOD policy influences contractor behavior, it does not steer it. This detachment is even more pronounced when DOD's incentives are not well-matched to the desires of industry as expressed in various surveys of contractor attitudes. The aerospace industry operates in an environment characterized by a multitude of variables over which they have only limited control. At times these variables can work in harmony with DOD policies. At other times they can operate independently or at odds with them. The remainder of this section describes these relationships more fully.

III. 2. INTERNAL AND EXTERNAL VARIABLES

The distinction between external and internal variables is not a complicated one. External variables are simply those factors which affect the capital investment decision which are imposed and or manipulated by entities outside the control of the contractor. The DOD policies discussed below are primarily external in nature. A second category of external variables are trends in the general economy such as inflation, interest rates,

and macroeconomic business conditions such as recessionary or expansionary cycles. A third category of external variables are certain financial constraints of individual firms. Although this classification is less rigid because firms can exercise options which affect these conditions, variables such as debt-to-equity ratios can still be considered "external" in that they are used by third parties in ways which influence firms. The willingness of banks to lend money, or the willingness of the public to purchase stock are often functions of the meaning of these financial ratios. Firms can take steps to make themselves more attractive to financiers, but for purposes of this discussion, they will be considered "external" in that the final decision often rests with entities outside the firm.

Internal variables are those factors in the investment decision over which firms can exercise more direct control. They are often expressed in terms of attitudes or goals such as capturing market share, entry into new product lines, etc.

The predominant criticism of DOD policy in regard to contractor motivation is that the policies fail to adequately take a multitude of these variables into consideration. In our literature analysis, the singlemost recurrent theme was that the overemphasis on profit as a motivational tool ignores a great number of other variables which actively constrain the capital investment decision. These other factors can easily overwhelm any industrial policy promulgated by the DOD especially when they are contract-specific, as opposed to the promotion by an industry of a firm of a comprehensive investment strategy.

It should also be remembered that the DOD plays a lesser role as a customer for aerospace products than it did ten or twenty years ago (Exhibit III):

EXHIBIT III ^{2/}

<u>Year</u>	<u>Percentage of Government Contribution to Aerospace Sales</u>
1955	84.7
1960	78.3
1965	76.9
1970	70.7
1975	55.9
1980	44.3
1982	55.4

Given the data in Exhibit III, it is clear that the DOD does not always have the power to create the stimulus-response effect it wants out of the industry given the latter's need to divide its attention between military and commercial markets.

III. 3. EXTERNAL VARIABLES

Profit Policies Enacted as a Result of Profit '76: This review of DOD policy begins with Profit '76 because it is the recognized benchmark which catalyzed a number of acquisition policy changes designed to stimulate capital investment in the defense industry. The central focus of Profit '76 was a comparison of profitability between defense-related and commercial-only (defined by FTC durable goods) business operations. The underlying hypothesis was that the reluctance of defense contractors

^{2/} Source: AIA, Aerospace Facts and Figures, 1983/84.

to make capital investments was directly correlated to the industry's poorer profitability compared to that which obtained in the commercial sector. The statistical evidence presented in the report demonstrated that discrepancy. The principal findings of Profit '76 were that:

- The pre-tax return on sales ratio of realized profits was higher for FTC durable goods producers than for government profit centers.
- The pre-tax return on sales actually realized on government contracts was significantly less (approximately 46%) than the profit rate negotiated by contracting officers.
- The pre-tax return on investment for government profit centers was higher than that achieved by FTC durable goods producers.
- The amount of capital investment per sales was higher for FTC durable goods producers than for government profit centers.

The conclusions that were drawn from these findings in terms of contractor investment strategy was summarized in a 1979 GAO report which stated that:

"Profit '76 showed that although contractor's profits on defense work, measured as a return on sales were lower than on commercial work, profits on defense work were somewhat higher when measured as a return on investment. This relationship was traced to a markedly low level of investment in facilities and equipment used in defense work -- less than half that used for commercial work when measured on the basis of sales. DOD concluded that there are many reasons for contractor reluctance to invest in modern machinery and equipment in defense contracts, but it is clear that some are rooted in procurement policy which fails to recognize adequately, either in profit or as an allowable cost, the facility investment which may be required for efficient operation."3/

3/ (GAO, PSAD-79-38; March 1979, p.1)

Several policy changes designed to stimulate greater capital investment were spawned by Profit '76. As mentioned before, most of these changes were intended to increase contractor profitability, in the belief that increased investment, productivity improvement and reduced costs were tied to higher profits.

While it is now generally recognized that a variety of factors influence a contractor's investment decision, most of the changes made as a result of Profit '76 were made with a long-standing emphasis on profit in mind. Armed Services Procurement Regulation (ASPR) 3-808.1 reflected this emphasis.

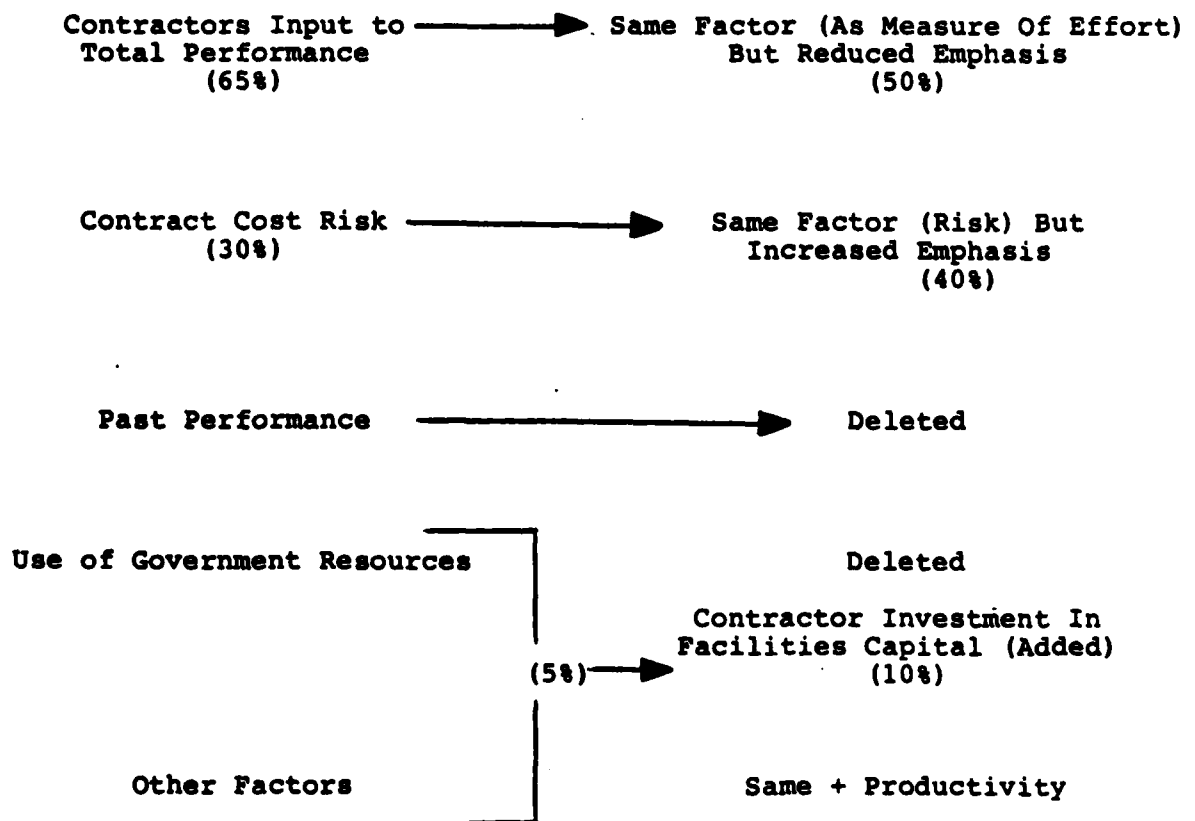
"It is the policy of the DOD to utilize profit to stimulate efficient contract performance. Profit generally is the basic motive of business enterprise. The government and defense contractors should be concerned with harnessing this motive to work for more effective and economical contract performance." (emphasis added)

Defense Procurement Circular (DPC) 76-3: DPC-76-3 was issued in September 1976. It sought to reformulate the Weighted Guidelines (WGLs) in such a way as to give greater rewards for contractor investment in new plant and equipment. The WGL technique of profit determination considers the relative value of several different "profit factors" used to establish a basis for profit targets. DPC 76-3 did not raise absolute profit levels (as a percent of total contract costs); it only redefined, and reweighted the values assigned to the categories in the market basket of factors on which profit is based: Contractor Effort, Contractor Risk, Facilities Investment, and Special Factors. (See Exhibit IV).

EXHIBIT IV

OLD POLICY

NEW POLICY



1. Facilities Investment: This addition to the WGLs allowed contracting officers to give an additional profit based on the value of the facilities investment that the contractor utilizes on a particular government contract. The policy was implemented by revising the WGL method of arriving at a pre-negotiated profit target as now embodied in ASPR 3-808.5, and was weighted between 6% and 10% of the profit rate. Prior to this revision, the value of the facilities needed to fulfill a contract was not included in the basket of items on which a contractor computed profit.
2. Contractor's Input to Total Performance and Risk:
(CITP) DPC-76-3 reduced the CITP weight from 65% to 50%. CITP measures a contractor's effort in terms of all resources devoted towards fulfillment of a contract, (materials, labor, overhead, G&A, etc.) DPC-76-3 also increased the desired risk weight from 30 to 40%.
3. Special Productivity Factor: A special productivity factor of 5% was added to the weighted guidelines to return the lost profit opportunity which may result if productivity increases by the contractor cause a reduction in the total cost base.

4. DPC-76-3 also revised the policy on the cost of money used for facilities. Effective October 1, 1976, DOD recognized the cost of capital committed to facilities as an element of contract cost. This recognition took the form of a cost accounting standard, specifically CAS 414. This standard does not consider operating or working capital; rather it provides an accounting treatment to develop an imputed cost which is determined by applying a cost of money rate to facilities capital. The cost of money rate is based on interest rates determined by the Secretary of the Treasury. The standard provides that a facilities cost of money factor shall be determined for each indirect cost pool to which facilities capital has been allocated and which is used to allocate costs to final cost objectives. The CAS 414 cost is not to be confused with the actual "capital employed" calculation used for Weighted Guideline purposes. The capital employed construct is one basis for profit determination, while the CAS 414 cost is an imputed cost paid to the contractor but not considered in profit determination.

DAC-76-23: By February 1980, it was believed that the changes embodied in DPC-76-3 had not brought about their intended results. A "mid-course correction", DAC-76-23 contained the following provisions.

1. It was found that the new CIP factor weighted between 6% and 10% was insufficient to influence contractor investment decisions. DAC-76-23 raised the margin to 16% to 20%.
2. It was determined that a universal investment-oriented profit policy for manufacturing, R&D, development and service contracts was inappropriate. DAC-76-23 created separate weighting margins for each type of contract.
3. DAC-76-23 established different weights for contractor risk according to contract type, in keeping with the notion that a firm with a fixed-price contract assumed a greater portion of total program risk.

Critique: The prevailing consensus on the effectiveness of DPC-76-3 and DAC-76-23 is that while they might have achieved their first order consequences (raising profit rates) they have failed to achieve their second order consequences (encouraging capital investment).

* From the AFSC's Profit '82 Summary Report:

"Overall, we concluded that profit, in and of itself, will not induce capital investment. In spite of the DPC-76-3 revisions emanating from the Profit '76 study, capital investment as a percentage of total cost did not change during the 1977-1981 period. Thus, the assumption that higher return on sales will stimulate investment on defense contract was not supported by actual experience. Profits were higher during 1977-1981, but relative investment did not change."

The concept of DPC-76-3 was generally sound in that, all things being equal, profits would increase only if capital investment increased. The structure designed to achieve this concept, however, was flawed. The capital employed profit factor was far too small, and the method of establishing capital employed on a given contract was too indirect. The problems with DPC-76-3 were further aggravated by DAC-76-23, which has resulted in only 60% of the assets assignable to defense contracts being recognized for cost of money and capital employed profit in 1981. Unless rescinded, DAC-76-23 will become a greater obstacle to capital investment."4/

- From "DOD Profit Policy & Capital Investment" (Janicke, Comfort et. al)

"Industry managers were virtually unanimous in believing that the intent of DAC-76-3 to provide an increase in profit for capital investment has not had any practical effect."

"Investment decisions by contractors are based upon a number of factors which generally outweigh return on investment. These factors include the necessity to comply with law, the need to remain competitive, and the need to replace old equipment."5/

- From a GAO Report:

"GAO found little indication that contractors responded positively to DOD's attempts to encourage greater investments in new or upgraded plant and equipment which would lower production costs. Although some added investments were identified, the reasons for making them were unrelated to DOD's profit policy."6/

"Most contractors were critical of the new profit policy. Some provided lengthy statements emphasizing serious problems. Some of the more frequent responses were:

- The policy lacks adequate incentives and has not achieved the objective of motivating contractors to make investments in cost-reducing facilities.

4/ AFSC, Profit '76 Summary Report: pg. xiv.

5/ Ibid, p. 30.

6/ GAO Report PSAD 79-38 (Covers only DPC-76-3), p. ii.

Many other factors not addressed by the new profit policy affect corporate investment decisions including the difficulty in planning major investments, insufficient profit in DOD business, and the need for funds to meet federal health and safety standards." 7/

Profit Policy and Cost Control: It should be remembered that the DOD's emphasis on profit policy has always been intended as a means and not as an end in itself. The rationale has been that cost control can be indirectly induced through the capital investments that contractors would make if they had access to more funds. There are critics, however, that contend that this indirect approach to cost-reduction has focused the energies of the DOD on the symptoms and not the disease.

Research conducted by Jack Runkle (USAF) entitled "An Assessment of Behavioral Influences on Defense Business Profitability" provided some key insights into the relationship of negotiated profit rates and total program cost. It was his hypothesis that the DOD practice of establishing a pre-determined contract profit objective prior to entering into cost/price negotiations with contractors was adversely influencing their profitability and productivity. His findings indicated that the government's pre-negotiated profit objectives were better predictors of the actual rate than the vendor's objectives, indicating that the DOD "drives" final rates. However, it was found that final prices are less constrained by government pre-negotiated profit objectives than are profits suggesting that the DOD

7/ Ibid, p. 6.

is more concerned with limiting profits than it is about total costs.

In another effort entitled "What are the Incentives in Incentive Contracts" the authors contend that paradoxically, some of the incentives designed to motivate contractors to adopt cost-saving measures, actually result in total program cost growth. Without delving into the details of the econometric model, it was shown that if the procurement process is viewed as a series of awards, each with its own set of profit minimizing and maximizing objectives, then:

"The results indicate that current institutional arrangements such as cost and profit-sharing create an incentive for government and industry management jointly to allow costs which result in subsequent cost growth."8/

III. 4. OTHER DOD POLICIES AIMED AT IMPROVING CONTRACTOR PROFIT-ABILITY AND CAPITAL INVESTMENT NOT NECESSARILY RELATED TO PROFIT '76

Progress Payments: DAR E-503.1 establishes the uniform standard percentages of progress payments to defense contractors. Progress payments compensate the contractor for labor, materials, and other costs incurred as the work on the contract progress toward completion. The usual progress payment is now 90% (recently increased from 80%) of the total costs for contractors other than small businesses.

For certain industries, recent revisions in progress payment policy have been credited with assisting contractors in their

8/ Boger, Jones & Sontheimer, Defense Management Journal, 1st qtr., 1983

efforts to purchase new equipment. Shipbuilders, for instance, can receive progress payments of up to 105% of incurred costs which has substantially improved their cash flow.

Unfortunately, because of high interest rates and time lags between contract performance and payment it had been estimated that progress payments pegged at 80% actually cover only about 60% of a contractor's working capital investment. Although the average rate has been lifted to 90%, it still does not adequately compensate the contractor for capital invested. Moreover, since interest on borrowed funds for working capital is an unallowable cost this further impedes a contractor's ability or willingness to reinvest in new capital equipment or technologies which might lower production costs.

Shared Savings Provisions: Shared savings clauses are used to incentivize contractor investments in modern production equipment. They provide contractors with financial incentives to invest funds in an approved capital investment program. The provisions apply to contractor-developed and documented Capital Investment Change Proposals (CICPs) and are limited to severable plant production equipment (excludes real property). The contractor's investment must provide savings which significantly reduce the cost of acquiring the new equipment. Shared savings arrangements are usually broken into two categories:

1. Value Engineering (VE): At its simplest, VE is a method whereby a product is redesigned in such a way as to reduce total unit cost. This redesigning can take the shape of an application of new technology,

Critique: The GAO has recently reviewed VE and determined that while the concept is sound, VE has failed to be as productive as it could be.^{9/} In its review, the Air Force received high marks for its VE efforts relative to other services, but the overall DOD goals have fallen far short of its goals.

9/ "Value Engineering Should be Improved as Part of the Defense Department's Approach to Reducing Acquisition Cost," GAO AFMD, 83-78; September 1983.

conservative by some value engineering experts, the annual savings opportunity may be even greater".^{10/}

In terms of the Air Force's own experience with VE, the GAO found that:

"Support for the value engineering program for contractors appears to have increased throughout the Air Force, with the Air Force Systems Command demonstrating the most significant improvement."^{11/}

2. Award Fees: Developed in the early 1960s, award fees provide incentives in contracts where performance objectives cannot be expressed in advance by definite milestones, targets or goals susceptible to actual measurement of performance. As such, they are most often associated with R&D projects because of their uncertain nature of the expected "deliverables", during which the Buying Office and the contractor submit project assessments to an Award Review Board, who in turn submits its evaluation to the Fee Determining Official (FDO). The FDO then determines the size of the award which is drawn from an "award pool". The fee decision and performance criteria are subjective and unilateral.

Critique: Based on our survey of literature on the subject, it seems that evaluations of the effectiveness of award fees are

^{10/} Ibid, p. iv.

^{11/} Ibid, p. 7.

mixed. While individual experiences with award fees suggest that in those contracts where they were used contractor performance did improve, it was not clear that this improvement could be directly correlated to the award itself.^{12/}

CAS 409: In addition to federal laws concerning depreciation, (which will be discussed below) defense contractors have also had to comply with DOD's own depreciation policy as it is embodied in Cost Accounting Standard (CAS) 409. At the time CAS 409 was implemented, the belief was that a depreciation standard was needed because charges that were based on income tax and financial reporting practices did not provide reasonable representations of the actual cost of the equipment used on government contracts. The standard did not dictate nor prohibit the use of any particular method of depreciation. Its key requirement was that the method used "reasonably reflect" the consumption pattern for the assets being depreciated. Unfortunately, the standard has been misread by some who contend that CAS 409 mandates depreciation periods and methodologies which are longer than those allowed under the Federal Accelerated Cost Recovery System (ACRS). In fact, however, a much more liberal approach has been taken to CAS 409 such that many companies now depreciate their assets for both IRS and DOD purposes on the same basis. In any event, efforts to revise the standards will be delayed since the

^{12/} "The Award Fee Incentive: Management Considerations Regarding Its Application to R & D Contracts," DSMC Program Management Course Study Project Report, Maj. Jerry Brown, Nov. 1976.

Cost Accounting Standards Board, an agent of Congress, has gone out of existence. Legislative efforts to transfer its functions to OMB are underway. The DOD is supporting this transfer as part of Initiative #5 in its Acquisition Improvement Program.

Critique: Although we have found no documentation to support the hypothesis that the ACRS and CAS 409 have motivated contractors to increase capital outlays, it would be difficult to imagine that these policies have had anything but a positive effect on their cash positions. Although U.S. and DOD depreciation policies still lag behind those of other industrialized nations, the new schedules are vast improvements over those which existed prior to 1980.

Termination/Buy Back Provisions: A major concern which defense contractors have in considering facilities improvement investments is the uncertain future of many DOD programs. In order to relieve that concern and encourage more capital investment, the DOD has occasionally agreed to purchase, at depreciated value, those of the contractor's fixed capital assets which were acquired for use on a specific program, if that program is later cancelled or drastically reduced.

In 1977, the DOD introduced changes to the Defense Acquisition Regulations which provided policy guidelines and methods to protect both Government and contractor interests which it felt were needed to enable wider use of this practice. The approach has the potential for stimulating increased contractor investment

in more efficient equipment. It is believed by some that if this provision of the DAR is carefully used that the cost of DOD purchased hardware could be lowered.

The importance of the indemnification provision, however, may lie more in its underlying "show of good faith" principle than in its day-to-day exercise. DOD has long been aware that the instability inherent in any of its Five-Year Defense Programs (FYDP) is among the main factors inhibiting contractors from making investments in new facilities. To the extent that the indemnification provision reinforces DOD's commitment to program stability, it may help to build the kind of confidence needed to attract capital into the defense industries.

III. 5. CONTRACT INCENTIVES/CONTRACT TYPE

Any discussion regarding the possibility of disjoining profits from costs must address contract types since it is the contract mechanism itself which is the practical manifestation of cost-based theory.

The notion of finding alternative approaches to cost-based contracts has periodically reappeared. Prior to the 1950s when most systems were relatively unsophisticated, fixed-price contracts were emphasized because overall program risk was low. With the end of the Korean conflict, however, the procurement needs of the armed services shifted from conventional ordnance equipment to increasingly complex and sophisticated systems such as guided missiles, electronic equipment and aircraft requiring extensive research and development and characterized by

significant cost uncertainties. For this reason, cost reimbursement contracts were the most frequently used method of procurement during this period.

As a result of severe criticism of cost overruns of systems under cost-type contracts, the 1960s witnessed an effort to modify their use. Procurement policy again swung towards shifting greater risk back to the contractor while at the same time providing a profit commensurate with the risk. Incentive and fixed-price contracts were employed whenever possible in order to facilitate competition and the assumption of financial risk by contractors.

Again, however, the pendulum swung back during the 1970s. As a result of substantial disillusionment from the recognition that major technical and cost uncertainty accompanies complex and usually insufficient defined systems, the 1970s saw a reversion back to more government risk assumption through cost reimbursement contracts for development until proof exists that the system is ready for production.

And again, if the mandate embodied in this effort is any indication, there is a renewed disillusionment with cost-based pricing in the 1980s. This shifting policy raises two questions.

First, why is it so hard to devise non-cost-based methods to pricing and contracting? The main reason for the persistence of cost-based pricing is that policymakers incorrectly believe that there are few practical alternatives. The longstanding reasoning is that for a great variety of programs, cost-based pricing or

cost-based contracts simply appear to make a great deal of sense. For any major weapon system which has not matured to the point of production or follow-on production, cost-type contracts are deemed appropriate. R & D, Prototype, and Full Scale development programs, because of their great technical uncertainty seem as though they cannot be accomplished under any other rubric than cost-type contracting. Cost-based contracts are even justified for programs which have fully matured because their instability seems to make (engineering changes or quantity stretch-outs) fixed-price contracts still inappropriate.

In our opinion, the belief that certain types of contracts can only be completed on a cost-plus basis is not axiomatic. It is an assumption that has been so deeply ingrained in procurement psychology that many fail to remember the theoretical basis on which it is founded.

It should be noted that the contract itself is simply an administrative mechanism that is used to adjust to the political peculiarities of the marketplace. The selection of contract type is driven by a parochial assessment of the technological risk associated with a single work effort. What is rarely recognized is that what the DOD is actually purchasing is not always products, but technical and industrial capabilities that it seeks to maintain in perpetuity. This can be more of a financial/management problem than a technical one. Some of the larger financial issues which impact on the ability of a firm to operate are subordinated to technical and legal issues.

Theoretically, all contracts could be universally fixed-price if the policy was willing to allow for a generous increase in profit on defense business. The ability to maintain greater earnings would obviate the need to closely control program risk by building capital reserves large enough to absorb the risks inherent in any series of defense contracts which define the true relationship of the contractor to the DOD. However, through a pervasive fear of "war profiteering", the DOD is pressured to drive profit rates down. In addition, it is quite possible that if given an improved capital base, firms would diversify out of critical defense areas in pursuit of other ventures. Therefore, cost-plus contracts are used which keep contractors "lean and hungry".

The second question is that aside from postulations of behavioral theory, there is no evidence that would show that cost-based pricing actually creates an environment which lacks any incentives to control total costs? Theoretically, it seems axiomatic that if a contractor knows that not only his operating expenses but his total profit are based on a cost-reimbursable system, there is probably a disincentive to adopt cost saving measures. But is this the way it really works? What is the actual relationship of contract type to the proclivity towards cost growth?

Many studies have tried to document the propensity of cost-based contracts to incur heavy overruns. One recent attempt

covered a sample of 300 Army contracts, each in excess of \$500,000 (see Exhibit V).^{13/}

Over the life of the contracts, each type experienced cost growth as displayed in Exhibit V. On the surface, the statistics would tend to indicate that indeed there is something about the very nature of cost-based contracts which allows for greater cost growth than in other contract types. However, when the components of cost growth and the way in which it is measured is considered, the relationship is less clear.

First, the data on cost growth and cost overruns usually is only measured in terms of the change in estimated program costs from one point to another. It rarely addresses the composition of the original cost base. An inefficient production structure which creates higher base costs is no more likely to exist in a program being conducted under a fixed-price contract than in a cost-based one. The relative efficiency of a program has more to do with functions of demand, schedule, capacity utilization, etc. than it does with contract type.

Secondly, the "basket of goods" that comprises the final overrun figure sheds little light on the relative economic efficiency of a given program. They are measured in terms of estimate inaccuracy, quantity changes, engineering changes, inflation etc. The theorized unwillingness or inability of contractors to control costs under any contract type is hidden in the method by which cost growth is reported.

^{13/} AD-PRO 007-3.

EXHIBIT V

<u>Contract Type</u>	<u>Average Cost Growth</u>
FFP	52.7%
FPI	10.9%
CPIF	117.5%
CPFF	50.2%

In point of fact, the annual funding process can result in increased units costs in fixed-price contracts which can be just as large as any found under a cost-based effort. Consider the data on the F-16 program (Exhibit VI) under a FFP basis.

As shown in Exhibit VI, although the F-16 is being procured on a fixed-price basis, the realities of schedule, financing, and other cost factors appear to allow for a perverse form of cost growth that has little to do with technological program risk or program maturity. Within 18 months the costs of building 96 planes as reported in the SAR of December 31, 1980 was almost double that shown in the SAR of September 30, 1979. Based on the analysis reviewed by the project staff, it appears that what is really being paid for is the provision of adequate cash flow to the firm to enable it to remain in the business of manufacturing F-16s. This is one of the underlying realities of cost growth which is often hidden in discussions of contract type.

There are many analysts who contend that contract-type has little or no influence on contractor behavior. In an address by Professor John Kennedy, he stated that:

"Extra-contractual factors seem to dominate in determining behavior. The contract type does not. For example, in discussions with chief executives, it became obvious that major corporate decisions were made on some other basis than contract type. Often top management is unaware of the particular contract type, and certainly the particular characteristics of complex incentives are generally either not known to management as a rule, or if known, rarely understood ...

Too often those in contracts overemphasize the importance of the contract type rather than the elements often outside the contract, i.e., the extra-contractual factors. The hypothesis that highly complex multiple incentives can be and are managed internally within the

EXHIBIT VI

F-16 Procurement (Then Year \$ in Millions) 14/

		SAR (9/30/79)		SAR (12/31/80)	
<u>FY</u>	<u>QTY</u>	<u>DOLLARS</u>	<u>QTY</u>	<u>DOLLARS</u>	
82	180	1,791.5	96	1,647.6	
83	180	1,760.9	96	1,679.7	
84	180	1,735.7	96	1,772.4	
85	180	1,753.6	96	1,745.1	
86	63	533.7	96	1,785.7	
87			96		
88			96		
89			96	5,486.8	
90			90		
91			21		

14/ "Program Stability: The Key to Cost Control and Efficiency in Weapons Systems Acquisition," Ronald Bowen, Student Report for Professional Military Comptroller Course, Air University, Maxwell AFB, 1982.

contractor organization, for example, appears fallacious."^{15/}

III. 6. TECHMOD

The Technology Modernization Program (TECHMOD) provides government "seed money" as direct performance incentive payments to specific contractors to bring high technology industrial modernization to the factory floor. A TECHMOD is generally accomplished in a three-phase effort. Phase I entails an entire analysis of a factory's operations to identify technologies which may be suitable candidates for integration into the manufacturing process. Phase II entails the selection of the appropriate technology with accompanying hardware/software requirements, implementation plan, etc. Phase III is the actual technology implementation. Phases I and II are chiefly funded by the DOD, while Phase III, the actual purchase of the equipment, is provided by the contractor.

Critique: The results of the TECHMOD program have been mixed. There have been some successful implementations of new technologies under the program (most notably at General Dynamics' Fort Worth plant constructing the F-16) and the Air Force has received higher marks than the other services' ManTech and IMIP programs. A number of problems, however, persist.

First, a TECHMOD application requires the need for long-range estimates of dollar requirements (three years), which must

^{15/} Professor of Marketing at Notre Dame in Address Before the Air Force Pricing Conference, 1982.

be accompanied by cost/benefit and payback analyses so that the DOD can choose amongst competing programs. This is obviously quite difficult to do when a system is immature and the exact tooling and production process configurations are not well established.

Second, the effort it takes to measure the cost-savings once implemented, cuts into the program's total value. As yet, there are no systems developed which can accurately track the savings once the program has been initiated. The size of the oversight staff that might be instituted for this function cuts into the cost savings that the TECHMOD was designed to generate.

A third criticism of the TECHMOD program is that it focuses on new technologies at the expense of existing, proven technologies which have not been utilized to the maximum possible extent. It has been noted that rather than pursuing expensive, untried, futuristic technologies, the DOD should expend more effort encouraging contractors to take advantage of more recent, familiar technologies. As one observer commented, "the problem in much of the aerospace industry is not to get them from the 1970s to the 1980s; instead, the problem is to get them from the 1950s to the 1970s."^{16/}

A fourth and broader criticism of the program is that TECHMOD has not been tied to a more comprehensive goal. While the implementation of new technologies which serve to reduce

^{16/} Maj. Edward McPhill, PS, Jr., "Incentives for Defense Contractor Capital Investment Programs on Negotiated Contracts. Student Report # 82-1675, Air University, Maxwell AFB, 1982.

costs is, of course, beneficial, it is argued that the program does not go far enough. In an article entitled "Impact of Corporate Resource Allocation Decisions on National Security Objectives: Dissynergism in Aerospace Industrial Resource Planning," it is stated that:

"The overriding problem with the new capital investment incentive initiatives is that they are focusing on the wrong basic objective and using some assumptions that may not be valid. The primary objective of DOD's new Industrial Modernization Incentives Program (IMIP) is to maximize industrial productivity growth. Instead, the policy objective should be to reduce unit production costs (given the required level of product quality to ensure operational effectiveness) and/or improve production surge capabilities for critical pieces of military hardware. Under this slightly modified philosophical approach, an appropriate capital investment incentive could more easily be tailored as one option in the implementation of a comprehensive effort to improve overall industrial responsiveness. In other words, the implementation of a capital investment incentive should be a means to an end and not an end in itself."^{17/}

The preceding discussion strongly suggests that the DOD's "external" attempts to motivate contractors to invest in productivity measures have fallen far short of their expectations. Yet, as also noted, capital spending and the profitability of the industry have substantially improved since 1976. It is our contention that other (non-DOD sponsored) external and internal variables have had a far greater impact on the capital investment decision. Those other factors are discussed below.

^{17/} Lt. Col. Mike Collins (AFPRO - Pratt & Whitney).

III. 7. EXTERNAL VARIABLES: NON-DOD

Macro-economic Trends: Probably the largest single deterrent to capital investment in the aerospace industry can be tied to trends which obtained in the general economy. After 1977 and 1978 general economic conditions in the United States were sufficient in and of themselves to deter defense firms and others from rapidly changing their internal investment policies to take advantage of tax or other regulatory incentives. The recently ended recession, for example, marked the worst business downturn since the Great Depression, and the U.S. has suffered three recessions in the past ten years. Moreover, even if investments were made it is known that there is an inevitable lag between the time that an incentive is perceived, implemented, and capable of having its effect measured in highly quantitative terms. This may be the case with many of DOD's programs; that they had to wait their turn to be implemented by industry and that sufficient time must pass before outcomes can be perceived and measured.

The above notwithstanding, there is an unresolved collateral issue of importance. That is the 20-year investment/disinvestment cycle apparently followed by the aircraft industry and the full meaning of this 20-year cycle for the industry's internal dynamics. It is possible that the increased capital investments now being made by the industry may not yield productivity improvements. It is instead possible and indeed likely that these investments reflect a much needed game of "catch up ball" in which basic facilities and capabilities are rebuilt. There is

some evidence to support this thesis. If this is correct, the cost base of the industry will increase unless concomitant cost-offsetting improvements are also made.

Federal Depreciation Policy: Depreciation policy was substantially revised in 1981 as part of the new administration's Economical Recovery Act (ERTA). Critics had long charged that among industrialized nations, the U.S. had the most "repressive" of all corporate tax structures. The House Armed Services Committee's Report entitled "The Ailing Defense Industrial Base" noted that in 1980 Switzerland allowed a 50% to 80% depreciation in the first year for new machinery, 100% in the U.K., 95% in Japan and 100% in Canada in the first two years. The U.S. lagged far behind with a depreciation schedule which allowed for a recovery period of 6 to 12 years for industrial equipment.

Instead of depreciation deductions, ERTA entitled businesses to "recovery deductions" under the Accelerated Cost Recovery System (ACRS) as the means of recouping their capital outlays made after 1980. ACRS eliminated the need to determine each asset's useful life, by applying a statutory percentage to the unadjusted basis of the property. The schedule now allows for a 10, 5 or 3 year recovery period depending upon the exact class of the equipment.

The Cost of Capital: Another deterrent to capital investment is the problem of the cost of capital. After 1979, interest rates in the United States reached historic highs. Although rates have since fallen, they have been and are still high enough to deter the use of debt to fund major capital investments by all

but the most profitable or cash-rich firms. The defense industries do not fall into either of these two categories. Although defense industry profit rates have improved substantially over the past two to four years, profits per se are neither large enough nor stable enough on their own to stimulate massive investments by defense contractors in non-liquid assets. When it is remembered that interest is a non-allowable cost such that "going-in" profit rates tend to overstate potential bottom line profit rates, the negative effect on the propensity to invest of the cost of capital becomes even more significant.

Here it is worthwhile to note that as interest rates have dropped, American industry in general, and the defense industries specifically, have increased their planned investments in new plant and equipment.

Financing: The availability of long-term financing is yet another variable that many DOD analysts have apparently neglected to consider in assessing the willingness of firms to invest in capital equipment. Rebuilding equity and cash positions was the most pressing problem facing the aerospace industry in the latter half of the '70s. However, capital investments are made only when "spare" cash is available or prospectively available. Other than Boeing, it was not until about 1979 that the aircraft industry regained financial liquidity. Thus, despite the incentives offered by the DOD in particular, and tax changes in general, most aircraft firms have been unable until recently to commit substantial sums of money to plant modernization. Capital formation incentives promulgated by the DOD prior to 1980, would

have been of little or no practical value to the industry. Because of capital structure problems, they would have lacked the requisite financial flexibility. Every prior analysis of the industry appears to have ignored this point. A firm's investment policies are dictated by capital structure considerations and not hypothetical DOD goals. When the more pressing need is to rebuild cash balances, capital investments will be postponed.

Interest Payments: As an adjunct to the discussion of capital structure, it also needs to be recognized that the DOD's position on the allowability of interest costs limits the desirability of debt as a source of funds for defense contractors. In order to recoup these costs, the defense contractor must increase his "going in" profit rate, an action that places constraints on his competitive position. Moreover, because of the disallowance factor, a defense contractor's interests costs are, in fact, paid out of profits which means that they cease to be a self-liquidating expense. Knowledgeable lenders are aware of these conditions and act accordingly by limiting the defense contractors' access to both short and long term loans. The policy is even more pernicious in the subcontracting base.

When debt is used to fund working capital the interest disallowance problem is acute. The problem intensifies when debt is used to fund investments in long lived, non-liquid assets such as plant and equipment. For all industries, debts of this type can only be repaid out of depreciation allowances, future profits, or a combination of the two. For the defense contractor, the problem of capital formation is compounded when it is

realized that debt service costs are, for all but tax purposes capitalized. This adds a double charge to the financial burden that the contractor must assume if he elects to use debt sources to fund investments in non-liquid assets. In sum, the prohibition against the payment of interest in government contracting may be yet another major deterrent to the underlying capital formation process in the defense industries, a factor that heavily influences their willingness to invest funds in new technologies and manufacturing equipment.

III. 8. INTERNAL VARIABLES

The Market: One of the key internal variables in the capital investment decision are the market trends in the industry. One need not resort to complex financial ratios in order to understand certain aspects of industry behavior. Actually, those ratios are but a statistical reflection of "what's going on" in the industry in terms of launched programs, failed projects, the exit and entry of firms, etc.

For example, it is unnecessary to focus solely on poor profit margins to account for the fact that the aircraft industry invested less per dollar of sales in new plant and equipment than any other industrial group in the early 1970s. The other reasons for this behavior are now reasonably apparent; a decrease in predictable demand for military aircraft; the heavy sums of money previously committed to the 747, DC-10, and L-1011 programs; and last, but not least, the very limited number of military aircraft that were to be built at any one time by any single manufacturer.

Given these circumstances, heavy investments in capital equipment in the aircraft industry in the early 1970s would have been foolhardy. The economic basis for the action simply did not exist then. Moreover, when the demand for military aircraft was finally generated, the annual throughput of aircraft per manufacturer was so small as to cast doubt on the economic value of substantial investments in capital equipment. To be cost effective, machinery must be scheduled to the highest utilization rates possible. Low production rates do not meet this requirement. Moreover, the benefits to be derived from capital equipment are generally dependent on long-lived production cycles. Where the product life cycle is short or the unit throughput is small, substituting capital for labor is rarely if ever economically justified. When the two conditions occur simultaneously, the wisdom of an investment in fixed assets is even more problematic. Thus, minimizing investments in capital equipment may often be the more logical option for an industry to pursue. In this environment, externally generated incentives calling for investments in long-lived, non-liquid assets will most likely be ignored.

Competition: The nature of competition also indicates the scope of an industry's reinvestments in capital equipment. Primarily, firms substitute capital for labor in order to attain or maintain a competitive position. Where competition is either dominated by, or appears to be dominated by a sales allocation system (such as the de facto DOD award process), incentives are

minimized. Support for this argument can be found in analyses of the military aircraft and shipbuilding industries.

Moreover, there is little reason, where allocation systems are believed to exist, for a defense contractor to "facilitize" after the receipt of a contract. Once a major contract has been won, the firm has been granted a virtual monopoly power on that product for an extended period of time. Competition ends with the award of a contract. Making heavy capital investments after the fact makes little sense. Moreover, if the greater portion of capital-induced cost savings must be returned to the government, the winning firm has no vested interest in promoting productivity if such an effort disrupts the normal behavioral patterns of the firm. Last, because of the winner-take-all nature of most major weapon system competitions, it would be bad business judgment to invest heavily in capital equipment prior to winning a major award. In most cases, the loser has no alternate use for much of the specialized equipment otherwise required to attain high levels of productivity.

This reality contrasts with the commercial investment strategies adopted by the Boeing Company. Despite the fact that it remains the pre-eminent commercial aircraft manufacturer, Boeing still faces real price competition in the commercial aircraft industry. This competition requires that it remain price competitive throughout the product life cycle of its aircraft. To accomplish this, Boeing invested substantial sums of money in cost-saving production line equipment for its new 757 and 767 class aircraft.

Profits & Profitability: So far, much has been said about DOD's attitude toward industry's profits. In short, profits have traditionally been viewed as the key tool for motivating a contractor's investment practices. DOD's profit policy was meant to correct what was perceived as poor profitability and investment in the industry within politically sensitive parameters.

But what is industry's attitude toward profits as they fit into their capital investment strategy? Surveys of contractors suggest in short, that while profits are necessary, they are far from sufficient. DOD's view that they are "the basic motive of business enterprise" is inconsistent with surveys of the hierarchy of corporate goals as expressed in various surveys.

Dr. Robert Williams, in an article entitled "So What Does The Defense Contractor Really Want?" attempted to see how well the DOD's perceptions of contractor attitudes matched up to their actual attitudes regarding the whole gamut of objectives. His overall conclusion was that:

"Government buyers tend to have ambiguous perceptions of the same objectives or wants in defense contractors. In terms of contractor objectives, they perceive profit on sales and improved cash flow, the short-term profit indicators, to be significantly higher than the lower-term profit indicators. This is the exact opposite of the industry rankings."^{18/}

Another study conducted by Thomas Anderson, jibed with Williams' findings. Based on a survey of 25 Program Contracting Officers within the DOD, Anderson found that

^{18/} Program Manager, March/April, 1983.

"DOD PCOs generally found profit policy ineffective in motivating contractors to invest in more productive plants and equipment and also felt that macroeconomic changes, such as revisions in tax laws would be more effective."19/

19/ "DOD Profit Policy - Its Effectiveness and the Contracting Officer's View", Naval Postgraduate Masters Thesis, 1980.

CHAPTER IV
CAPITAL INVESTMENT & PRODUCTIVITY

The preceding section dealt with policies designed to motivate contractors to increase their capital investments in new plant and equipment. This discussion has had two implicit assumptions: first, that these expenditures, and especially those which substitute capital for labor will result in substantial improvements in productivity; and second, that if these improvements in productivity do result in cost savings, then they are of a magnitude which is worth pursuing in lieu of other cost-saving strategies. These assumptions are investigated below.

IV. 1. CONVENTIONAL WISDOM

Productivity improvements are most often equated with a reduction in the quantity of the production line labor used in the manufacture of a product. This conventional view gives rise to the "substitution of capital for labor" thesis which posits the replacement of production line workers with machines as the basis for improving industrial productivity. As more current experience shows, this may be too narrow an approach in that it neglects the overall potential that firms have for reducing all manners of other costs. Focusing cost reducing activities solely on the production line leaves untouched, for example, as much as 70% to 80% or more of the final cost of producing a weapon system. This would appear to be a short-sighted approach.

As the U.S. automobile industry has belatedly learned, productivity can also be improved by reducing the number of management and administrative personnel and restructuring the firm to a permanently lower cost base.

In this instance, the more relevant definition of productivity is:

$$P = \frac{\text{total unit output}}{\text{Total labor costs}}$$

Where P = Productivity, and total labor means the full costs of labor including non production line labor, overhead, etc. Change in productivity then, is defined as:

$$P_i = \frac{\text{total unit output}}{\text{total labor costs}}$$

Where P_i = a change in Productivity.

For improvements to obtain P_i as defined, must be greater than 1.0. However, as the equation suggests, productivity as measured can both increase and decrease.

The rub in accepting this definition is that productivity improvements as defined here are not confined solely to the factory floor, but may instead be sought throughout an entire organization. However, internal corporate pressures against adopting so broad an approach to productivity improvements are quite severe. Despite a surfeit of management theory that addresses the control of overhead costs as a way of improving a firm's competitive position, most firms find taking this broad-based an approach difficult because of internal corporate

pressures to the contrary. In general, cost cutting of this type is most normally taken only by industries or companies whose backs are to the wall. Because most major U.S. industries are oligopolies that prefer predictable and stable prices and markets, direct price competition is generally avoided. The net result of this market structure is that the competitive pressures generated in this type of environment do not generally require the type of drastic cost control procedures which are being suggested here. It is only when there is inter-industry or foreign competition, e.g., ships versus commercial aircraft as a mode of transportation, foreign-made versus domestically-produced products, that the marketplace drives the forced restructuring of an industry. This is because the choice then becomes one of improving productivity or losing marketshare to interindustry or foreign competitors whose view of the market is not symmetric with that of the original competitor.

The rub in defense procurement comes when it is realized that the DOD must generally do business with either monopolies or oligopolies that are protected from foreign competition. However, unlike other consumers, the DOD can invoke a modicum of monopsonistic power. The DOD, for example, has the legal ability to force the competitive restructuring of the U.S. defense industrial base. It can do this by capping the allowability of a broad range of costs or by using competitive techniques routinely available to it. That it has rarely used the extreme forms of this power reflects the fact that it does not have the required political mandate. Despite the substantial lip service paid to

the notion of enhanced competition, the DOD is understandably unwilling to face up to the political consequences of pushing competitive pressure to the extreme, i.e., allowing a major firm to go bankrupt or the taking of actions which expose the U.S. defense industrial base to foreign competitors.

Thus, from the perspective of both the DOD and industry, emphasizing the typical substitution of capital for labor approach to productivity improvement is more palatable. Although a major effort directed at the pressured substitution of capital for labor threatens the number of production line jobs, it stops short of threatening enterprises. One is an acceptable mode of behavior; the other is not.

IV. 2. THE ENTERPRISE VIEW

Politics notwithstanding, the enterprise view of productivity improvements may be the more worthwhile concept. For the strong of heart, there is substantial pay dirt here. First, the broader approach puts the entire firm on the line and not simply the production line worker. Second, and perhaps more important is the fact that it forces top management to reevaluate its responsibilities for the efficient management of the firm all the way from the corporate suite down to the factory floor. As a number of major industries are now finding, concentrating solely on replacing production line labor with machinery avoids the need to come to grips with cost saving management technologies whose use may stimulate a more comprehensive review of a firms structure and operations, and a much needed rethinking of corporate

corporate strategies. Boeing's experience in the early 1970s is relevant here. It reorganized an entire firm in order to gain worldwide dominance in the commercial aircraft industry.

Furthermore, it is now becoming evident that concentrating solely on replacing production line labor with machinery is an insufficient cost saving technique in most high technology industries. These industries generally use minimal amounts of "touch" labor such that the costs absorbed by direct labor personnel may not be great enough to generate perceivable and/or significant productivity improvements.

Another reason why the substitution of capital for labor may not result in substantial cost savings relates to the problem of capacity underutilization and low levels of throughput. For example, available evidence suggests that even Boeing needs to produce between 300 to 350 aircraft per year in order to realize economies of scale. This is about half the number of total aircraft the DOD has annually purchased from as many as six active producers over the past five years. For other than the F-4, no fixed-wing jet aircraft manufacturer has attained Boeing's level of output since the early 1950s. Nor is it likely that any firm will ever again attain that level of output. A mass production scenario for aircraft which would derive the highest payback from new manufacturing equipment is most likely a thing of the past. Consequently, the industry is in the process of adapting to this reality and is restructuring its capital investment policies accordingly.

There is evidence that the aircraft industry is responding in one way by developing "specialties." Vought, for example, specializes in tail assemblies; Rohr in nacelles; Boeing in wing assemblies. In passing, we would mention that this type of restructuring might be one of the main contributors to system cost growth. Conversely, this restructuring might also be "masking" certain improvements in productivity. This is because it is conceivable that each firm may be improving its productivity in its own speciality, but that these productivity-generated savings are more than offset by the layering of overhead in the new "industrial combine" method of aircraft construction/integration. In other words, each "tier" in the industry may be striving for efficiency, but costs may continue to rise due to a lack of vertical integration and its effects on the "make-buy" decision. Accepting this hypothesis allows for a more coherent explanation of the industry's investment patterns in the post Vietnam period.

Furthermore, some theorists argue that an overemphasis on capital investment as a means to productivity improvement has certain theoretical and practical flaws. In an editorial entitled "Emphasizing Capital Investment is a Mistake"^{20/} Jackson Grayson, Chairman of the American Productivity Center makes a number of interesting points.

First, Grayson contends that it is unclear from statistical evidence that capital investment is the major cause of either

^{20/} Wall Street Journal, October 11, 1982.

economic expansion or productivity slowdown. This is because the underlying assumption is backwards: capital investment is not the key to higher productivity, but rather, "the causal linkage runs the other direction, that is, that high investment is the result, rather than the cause of productivity growth." He quotes a Japanese researcher who stated that "investment is not necessarily the determinant of growth, it being likely that better growth prospects attracted more investments in a number of industries."

Second, Grayson alludes to the argument posited earlier; that the structure of manufacturing is moving away from those conditions which benefit the most from capital investment, e.g., long production runs, economies of scale, standardization, etc. Manufacturing behavior is being altered in ways which require new outlooks on the size and shape of investments.

Third, he posits that managers tend to confuse the volume of investment with the productivity of investment. More investment may increase volume but produce little or no improvement in productivity. Our literature search revealed other analysts who shared this belief. John D. Baxter, writing in Iron Age estimated that equipment productivity (measured as dollars of revenue against dollars invested) declined by 27% between 1965 and 1979. Baxter ties this slide primarily to the underutilization of costly equipment:

"In sum, it was just not possible for manufacturers to closely match their equipment purchases with economic growth, i.e., market demand, in a period of wild cyclical swings as occurred in 1966-79. They bought equipment based on great promises of strong upswings in

the economy - only to later watch in shock as the economy took one header after another.

In the 1966-79 period, manufacturers were caught with factories full of new equipment operating well below optimum levels much of the time. Inevitably, the payback, or productivity, of that equipment was hit hard."21/

In sum, capital investment is an important part of the productivity equation -- but not the only part. What we are suggesting is that there is a need for a broader perspective on the actions needed to improve the cost-efficiency of the systems acquisition process.

IV. 3. PRICING POLICY, EFFICIENCY AND RELATED MATTERS

It has been argued elsewhere that the forced substitution capital for labor may neither be the most viable nor effective technique for accomplishing this goal, because of the relatively small contribution that direct labor costs make to total product cost and because the specialized nature of the equipment requires high utilization rates in order to pay-off. As suggested earlier, there are other expense pools substantially greater than the direct labor pool which are equally, if not even more, accessible to management action and control. What is needed then, is a pricing/profit policy that incentivizes top management to conduct a top-down review of its entire organization. Without this top-down review, the radical surgery that may be needed to constrain defense costs will never be considered. This may be a luxury we can no longer afford.

21/ June 22, 1981.

However, radical surgery is not possible unless it is recognized that where an allocation system exists which sequentially provides sales dollars to firms competing in a specific segment of the defense industries, the affected firms have no pressing need for distinct cost advantages over their competitors. When the time comes, the winning firm will not be rewarded for its manufacturing sophistication, but rather for its patience or political strength. Although competing firms may seek to gain a technological advantage at the concept and design phase of the acquisition process they may perceive, given the prior evidence on the allocation process, that they have no pressing need to gain a manufacturing advantage if this means investing more dollars in machinery and fewer in people. This leads to a collateral and potentially confusing statement; that is, that accounting procedures which measure capital investments in terms of things and not people may be an inappropriate measure for high technology industries. If military aircraft manufacturers and other high technology firms see themselves more as the producers of designs and concepts and less as the managers of efficient manufacturing plants, no change in price, profit or investment policies will force them to rethink their corporate strategies on investment or product-cost control.

If this tentative conclusion is even remotely valid, one may safely assume that the DOD is limited in its ability to constrain the cost of major systems. One way, however, would be to limit a firm's Independent Research and Development (IR&D) and Bid and Proposal (B&P) expenditures inasmuch as this is where the costs

of the "capital investments" in people (rather than things) are hidden. For accounting purposes, these costs are expensed although in practicality they should be capitalized. This provides for the possibility for major misperceptions about the capital structure of the defense-oriented firm and can lead to the promulgation of incentives that may only moderately if ever affect its concern with manufacturing efficiencies. Put another way, many of the current incentives provided by the DOD assume either that the defense industries are capital intensive or that they should be. Moreover, the incentives are based on the assumption, that the defense industries desire to be capital-intensive. This interpretation of conventional economic theory with its uniquely American overtones may be inappropriate when applied to the defense sector. This is because the defense industries remain labor-intensive (though not necessarily production-labor intensive) as a hedge against the instability of the demand for their products. The failure to make capital investments cannot be necessarily tied to their inability to afford them. It is that remaining labor-intensive allows them the flexibility that is required because the customer (DOD) cannot stick to predictable production rates, engineering designs, etc.

That said, it must be recognized that any workable incentive or modification to the existing price/cost system will invoke a response by the industry. At issue, then, is the need for earlier decisions on what the incentives are to accomplish, e.g., an enlarged defense industrial base, one that is vertical in structure, or other outcomes. It is possible, for example, to

invoke a pricing policy that accepts a bid price but requires that specific post-acceptance costs be cut with no decrease in the price and/or fee to be paid to the contractor. This technique could be used to gradually reduce the cost of a major weapon system by rationalizing the internal structure of the defense oriented firm.

However, even this policy has its risks. Limiting a firm's involvement in IR&D activities may also improperly deny a firm's ability to bid on any and all contracts of interest, and in so doing, force product and/or service concentration in the defense industries. Consequently, a pricing approach such as this may be interpreted as impacting on the marketing policies of defense contractors and forcing them to limit the numbers and types of business to which they seek entry. Pursued to an extreme, a policy such as this could develop a defense industrial base centered in one group of firms which specializes in R&D and another group which specializes in manufacturing. Intriguingly enough, a greater emphasis on second-source competition during the production phase of the acquisition cycle can lead to the same outcome. However, a pricing policy that incentivized firms to cut costs by reducing the range of services they offer the DOD is a form of the "top-down" action which could ultimately reduce the current emphasis on R&D and increase the emphasis on manufacturing strategies, an emphasis heretofore neglected by most segments of the defense industries.

Until the DOD is recognized as being serious about promoting cost constraining competition, even to the point of allowing a

number of major defense contractors to go out of business, much of the stated concern with productivity and competition will be skeptically viewed.

That no large defense contractors have dropped out of the business because of competitive pressures means that price as an economic phenomena does not fulfill the same market clearing role in the defense industries that it ostensibly plays in the commercial sector. In the commercial arena, firms either remain price competitive or lose marketshare. Given the current political and contracting environment, there have been virtually no marketshare losers in the defense sector. This reality is not conducive to creating an environment of tight productivity control which bring about cost reductions. Moreover, no "fine tuning" of the price system itself will bring about these controls if no firm is ultimately required to pay the price for the risks assumed in pursuing a contract for a major weapon system.

CHAPTER V

THE THEORY OF ALTERNATE APPROACHES

V. 1. INTRODUCTION

The purpose of this project is to develop a new approach to the pricing of major weapon systems which has the potential for accomplishing the following goals:

- Unlink costs and profits in defense contracts in such a way as to bring about lower costs for weapon systems.
- Motivate contractors to make efficiency improving capital expenditures.

A subsidiary goal of this project, to be accomplished by a literature review, was to determine why prior DOD efforts to accomplish the two goals noted above have failed, if indeed they have.

We believe that it is now possible to outline the content of a new approach which may have merit. This is really the "creative" segment of this report.

Before outlining this approach, however, a number of issues need to be discussed and considered.

- First, there is no incontrovertible proof of the adequacy or inadequacy of the incentives previously developed by the DOD in response to the dual problems of high price and low productivity. Despite the

critical consensus on these incentives, it was not argued that they were misguided. It was that the incentives were simply "overtaken" by trends in the overall economy and by more immediate concerns of the aerospace industry. Given the proper economic environment in which to operate, there is no basis for believing that these incentives cannot work as designed. The jury is still out on this issue because of the confused condition that dominated the U.S. economy from 1977 to 1983. High inflation and the interest rates have acted to make a substantive analysis of changes in the structure and operation of the defense industrial base less informative than they might have been during periods of relative economic stability.

- Second, the industrial base responds to a broad range of economic and political stimuli of which the DOD's policies may be the least powerful. Moreover, these policies treat industry as if it were an abstraction; able to respond immediately to the "logical" whims of the Congressional and Pentagon bureaucracies responsible for overseeing their operations. An immediate response is not possible in the real world. Capital is an instantly fungible asset in theory only. The real world, to use an economic expression, is far more "sticky" in that time is required for an "economic requirement" to be perceived and acted upon. More time

is needed before measureable results can be obtained and verified. Asserting that prior incentives have not provided the results expected of them may be misleading unless sufficient time has gone by for proper measurements to be made.

- Third, and more critical to the analysis that follows and the recommendations flowing from this analysis, is the fact that the "real world" of economic action/reaction is not unitary. By this we mean that there are many valid theories and explanations of economic behavior, each based on its own set of a priori assumptions. Each is based on its own set of value judgments as to which economic outcomes are either "good" or "bad", and each relevant for describing and/or explaining a different set of outcomes. For instance, a procurement philosophy which concentrates solely on buying weapons for the lowest possible price is "good" under one theoretical construct. If that philosophy, however, results in the loss of some jobs, then according to another theoretical construct, it is "bad". Value judgments can only be made when goals are clearly defined and priorities established for attaining these goals. The unitary nature of economic behavior often assumed by Congressional and DOD officials when promoting legislation and regulation simply does not exist.

The world is far too complex for this to happen. Until this point is realized and taken into account by public sector decision makers, the likelihood of any substantial improvement in the defense acquisition process will, at best, be made more random and, at worst, be minimized.

V. 2. ECONOMIC THEORIES

To understand the judgment set out above, we need to posit two opposing theories of economic behavior.

The first is the traditional one of price theory in which it is assumed that prices are set by market forces and that prices control the flow of resources in and out of sectors of the economy. Under this construct, profit is a residual and can either be positive or negative based on factors which may be beyond the control of either the buyer or the seller. The marketplace is not "responsible" for guaranteeing the profitability of a transaction nor is the marketplace responsible for guaranteeing or otherwise protecting the capital formation process in a given sector of the economy. Whatever obtains, be it disinvestment or investment, profits or losses, is the reflection of the impersonal nature of the free market action best described by Adam Smith.

A second explanation for economic behavior is that of the welfare economics. It is more concerned with the distribution of income to and between different groups of people and the equity

or fairness with which these distributions are made. Theoretically, price theory rests on leaving the decision on the allocation of resources to the free market. Welfare theory, to the contrary, assumes that government must and will take a proactive role in establishing and maintaining desired economic outcomes. Ultimately, one of the key tests of welfare economics becomes that of "fairness" or "equity"; a social or political judgment as opposed to a purely economic judgment. Because there is an explicit social or political good that is actively considered, profits are regarded not simply as the residual of the interplay between various market factors and costs, but rather as the provision of a socially essential "return to equity" dictated by broader concerns than simply the creation of market-clearing prices. A return to equity approach is, as is obvious, far different than the "return to risk" precept that dominates most price theory formulations.

In general, welfare economic concepts have more relevancy for communal or collective goods, i.e., defense purchases, public utility services, than does price theory. Price theory is more appropriately applied to the purchase of goods for private consumption. The most cogent reason for the use of welfare economic theory for communal or collective goods is that their purchase is either a politically-oriented decision (such as the election of weapon systems) or the purchase of goods from a legislated monopoly, i.e., public utilities. In addition, when public funds are used, they are normally spent with a number of goals in mind. This then dictates the requirement that the use

of these funds meet some of the tests of welfare economics, i.e., equity, fairness, and other social or national goals. Last, there are a large number of products for which a market price cannot be determined. Weapon systems are, again, an example of a product whose lack of a marketplace nullifies the complete application of price theory. For most defense goods, the theory of welfare economics is the more relevant but for the unfortunate connotation of the word "welfare". In this instance, the appropriateness of the word "welfare" is apparent when we think in terms of establishing a "fair" profit. In the private sector, a fair profit is whatever the market will bear. The notion of determining what is a "fair and reasonable" profit for a defense product is not an economic construct only in terms of a welfare-based approach. Our use of the word "welfare" should be clearer when thinking in terms of "an equitable" distribution of defense dollars among the 50 states. The practice of "pork barreling" may not be economically efficient or popular, but it is a political reality whose roots lie in the notion of the "fair" distribution of wealth that is the basis for much welfare theory.

In addition, the use of public funds is usually based on the notion that the expenditure of these funds will generate desired first, second, and even third-order consequences, i.e., the attainment of a multiplicity of public goals. In conventional price theory there is no expected social outcome beyond the satisfaction of the individual consumer who purchases the product. Because the consumer can elect to buy or not to buy, and because there may be many substitutes for a desired commercial

good, no social concerns are attached to the purchase of these goods in a developed economy such as in the U.S. The purchase of defense goods, on the other hand, often has a series of second or third order consequences attached to it. Using defense dollars to maintain jobs, to keep the U.S.'s R&D expertise up to par or as offsets for Foreign Military Sales purposes are not unfamiliar goals. In short, consumer purchases hold no "unseen agendas", while defense purchases often have purposes which go beyond the immediate satisfaction of tactical needs.

Put differently, there is an imperative in the expenditure of public funds which need not be considered when private funds are being spent. This difference is more than nominal in that the normative perceptions of the need for and existence of a fair price varies according to the theory selected. As noted earlier, the price established by recourse to welfare economics must meet the test of "fairness", "reasonableness", "equity", or some similar adjective. Under price theory there is no such notion as fairness.

Establishing a fair or reasonable price then gets to be a "mathematical problem" for the welfare oriented buyer. In the real world, this gets translated into an "average full-cost" construct because of the accounting ease with which such a measurement can be made, validated, and justified. Under the mandates of the full-cost thesis, all of the costs incurred in the production of a good or service plus a profit are to be recovered by the entrepreneur. This process then shelters the entrepreneur from many of the business risks he might otherwise

face. Because of this, the concept of profit as a return for investment is far more appropriate in a welfare-oriented system than a profit return for risk concept. This is because the welfare approach tends to minimize business risk. That is one of the key purposes for the use of such an approach particularly in pricing the services of public utilities where there is the same "base maintenance" requirement as there is in the defense arena. Taken to an extreme, the notion of attaching a profit to a cost-based contract is a theoretical absurdity. If profit is the reward for having assumed some degree of risk and if there is no risk (to the contractor) in a cost-based contract, then "profit" is no more than "topping-off" a contractor's cash flow at a pre-determined level.

Based on much of our work on the structure of the defense industries, we are now convinced that the major weapon system acquisition process has, for the most part, been organized consistent with a welfare economics perspective. Here we find two systems acquisition procedures particularly significant.

The first is the use in defense contracts of reimbursable overhead rates based primarily on a full cost pricing thesis. The explicit use of overhead rates in the systems acquisition process acts to minimize risks for the entrepreneur while implicitly but effectively providing base maintenance funding.

The second is the use of the WGLs. The use of the WGLs for establishing profit rates, despite the language used, is the application to defense contracting of a return to capital ap-

proach. Neither of these two contracting procedures is essential where recourse is made to price theory.

Conventional price theory, to the contrary, does not concern itself with artifacts such as reimbursable overhead rates since market forces drive price and profit. In turn, price and profit spur the need for more efficient operations. Profits become a function of productive efficiency and the marketing shrewdness of the entrepreneur and not a factor to be negotiated between buyer and seller. Under the tenets of price theory, profit is more generally a reward for risktaking.

In price theory, the more relevant concern of the entrepreneur is not average full cost of a product but its marginal cost, i.e., his ability to induce a more favorable supply/demand relationship than might otherwise exist. Put simply, the marketplace is "king"; it determines "who wins and who loses." Last, the concept of a pricing system even partially adapted to a "business-base maintenance" requirement, as is the case in the defense industries or public utilities, is non-existent in price theory.

V. 3. DISCUSSION

The differences discussed above are far from semantic. The use of one approach versus the other implies the acceptance or rejection of a broader culture of economic behavior. It is the resulting culture that is significantly more important than its theoretical underpinnings particularly since they are more often than not are poorly understood and constantly shifting.

This last point cannot be overemphasized. Economic events are far more complex than the theories used to describe them. Ultimately, it is probably safe to say that virtually any economic transaction has both welfare and price theory implications. In the private sector the existence of this joint relationship can be ignored. In the public sector this relationship can lead to the creation of an economic culture that may be difficult to categorize and manage because it is in fact an economic hybrid. In our opinion, the procedures used to acquire major weapon systems have created an economic culture that responds to both the imperatives of price and welfare theory simultaneously but in a confused manner.

The real world problem then becomes a change of ground rules which, depending on the outcome desired, gives greater credence or priority to one set of economic rules as opposed to the other.

CHAPTER VI
THE APPLICATION OF ALTERNATIVE APPROACHES

Preface

Before turning to the discussion of some of the elements that must be considered in the development of a new pricing approach we believe that it is worthwhile to state the key criteria that we believe must be met in order to promote cost savings and efficiency in the defense industrial structure that is adopted.

Any new pricing approach must promote the greater use in the defense acquisition process of prices based on a marginal cost concept.

Let us also restate the realities that must be understood in thinking of adopting alternative approaches to the pricing of major weapon systems.

- First, the prime reason for the failure of many prior DOD efforts to attain their desired goals of reducing prices or increasing contractor performance is that it is impossible to "tinker" with a system as subtle and pervasive as a pricing system. If price theory is relevant to the defense acquisition process (and we do not believe that it is for the bulk of defense procurements) then any successful policy must be primarily directed at changing whatever the supply/demand relationship may be. Even enhanced competition, which is probably the only effective policy tool available to the DOD has its hidden costs if the need for competi-

tively based prices requires the maintenance of redundancies in our defense industrial base.

- Second, and far more subtle in our opinion, is the fact that many of the policies promoted by the DOD and others have their basis in welfare economics. If this contention is correct, it is unlikely that these "tinkerings" will bring about the desired price reductions and improvements in contractor performance. The use of the WGLs, the average full cost in negotiating contracts for major weapon systems, and the provision of special incentives for capital investments are techniques which are most applicable when goals can be stated in terms of a desired welfare outcome. These policies have little validity, and indeed may be counter-productive when the desired results are those that obtain only in an economy oriented to the full force and practices of conventional price theory. The greater proportion of our defense dollars spent for major weapon systems are spent in an industrial base no longer structured according to the mandates of price theory. This base is not fully and thoroughly competitive such that price performs the market clearing function that it is supposed to do.

Most of the techniques developed to improve the acquisition system are, in fact, derivatives of a welfare economics approach

and therefore unlikely to promote the cost reduction and contractor performance goals of the DOD.

In a different vein, most DOD price and investment policies treat the industrial base as if it were homogeneous. In point of fact, it is two-tiered:

- The top 20 to 25 contractors who control 50% or more of the acquisition dollars.
- Everybody else.

The importance of this statement is that the top 20 to 25 (or even top 50) of the defense contractors may need to be treated differently than everybody else. Let us explain.

In all likelihood, most small or smaller contractors may now feel more "real" competitive pressure than their larger, more powerful counterparts. To the extent they do, it is more than likely that they have structured their prices and cost in reasonable consonance with conventional economic theory. By this, we mean that they are probably more responsive to underlying supply/demand relationships than the very large contractors, and are more willing to use marginal as opposed to full-cost concepts in deriving bid prices for government contracts. If this is so, then they are already responding to market forces. The effect of DOD policy on their management strategy, therefore, is apt to be minimal. Indeed, in practical terms, it may be completely irrelevant to the underlying business concerns of this very large number of firms. There is one possible exception here; except for the WGLs, they might well bid a lower profit rate than they are now doing.

At issue, then, is the impact of DOD price and investment policies on the top 20 to 25 defense contractors. Our belief is that these policies may in fact be counterproductive in that they promote business and financial practices more relevant to public utilities than to industries ostensibly organized along more competitive lines. The average full cost thesis underlying the financial philosophy guiding the acquisition process is, in our opinion, more relevant to public utility theory than it is to the environment in which highly competitive prices are the stated goal.

Similarly, the use of WGLs is more relevant for public utility theory where negotiated profit levels form the basis for providing the utilities low cost access to the capital markets. Any implicit "guarantee" or explicit negotiation of profit levels is inconsistent with price theory. Nonetheless, the goals articulated in various DOD policies call for behavior that is only consistent with price theory. In our opinion we have a critical intellectual, theoretical and practical contradiction in thought and practice. In very simple terms, we are saying that we may have been using the wrong economic tools to obtain the results we desire.

VI. 1. THE APPROPRIATE APPLICATION OF THEORY

That said, it should be remembered that if among the goals of major weapon system acquisition is the maintenance of a defense industrial base with some level of redundant capacity, then the use of welfare theory is justified.

Where some level of redundancy is required, competitive pressures must be blunted. The use of an average full cost thesis helps to accomplish this.

Put another way, we cannot have it both ways! We are not arguing that the welfare or price theory approach to procurement is either "good" or "bad". What we are saying, is that as it is presently conducted, the industrial process in which the acquisition of major weapon systems is imbedded is akin to that found in welfare economic theory. If that is so, then pretensions and facades of a free market environment should be discarded. If the realization that procurement is conducted according to welfare economic dictates is distasteful, then policies should be adopted to bring the acquisition system into line with a true price theory approach, i.e., the assumption of greater risk by contractors, the elimination of cost-reimbursable concepts, etc. We cannot have a redundant industrial base with built in surge capacity and fully competitive prices. Intellectually and pragmatically the two are non-sequiturs. A price is paid for unused industrial capacity.

Similarly, we cannot use the defense budget to allocate funds between geographical regions, or to stabilize employment in a given location or skill specialty and also have fully competitive prices. These are redistributive goals consistent with the application of welfare theory and inconsistent with the application of price theory.

If lower prices and a more efficient industrial base is required, it now appears reasonable to conclude that such welfare

economic artifacts as average full cost pricing and the WGLs need to be scrapped and the defense acquisition system be as fully opened to competitive forces as possible.

When cast in this light, this may be an inappropriate national goal. What may be more desirable is a pricing structure which preserves desired elements of both price and welfare considerations.

VI. 2. THE ENTRY/EXIT PROBLEM

The justification for a middle of the road policy -- neither the most efficient nor the most inefficient defense industrial base -- may well be found in the Entry/Exit Problem. Full recourse to price competition as a structural device would most likely mean that there must be easily identifiable "winners" and "losers". If the losers were to drop out of the market it would force a rationalization of the defense industrial base consistent with whatever the peacetime scenario might then be.

Rationalization is a desirable goal but only if other firms can enter into the defense industry easily and quickly if and when the need arises. This last statement cannot be overemphasized. If the rapid entry of new competitors is difficult, if not impossible, in times of national emergency, then the rationalization of the defense industrial base to a peacetime scenario makes neither economic nor military sense.

This decision is well beyond the scope of this report. However, it is a major consideration that needs to be taken into

account if a new approach to the pricing of major weapons systems and industrial efficiency is to be applied.

There are, to sum up, significant trade-offs between industrial capacity and capability and industrial efficiency that need to be considered before any major changes are made in the business techniques used to procure major weapon systems.

VI. 3. THE IDEAL ACQUISITION SYSTEM

From the perspective of price and cost control, the ideal situation for defense contracting would be to have three to five technically qualified contractors available for each procurement. Moreover, the contractors, ideally, should be able to meet the following business conditions:

- Be operating at relatively high capacity utilization rates.
- Be profitable.
- Be and desire to remain inherently competitive.

Given that set of circumstances, then the price bid by any of these firms for a procurement would, in the presence of competition most likely be based on a marginal cost construct as opposed to a full cost concept that now appears to dominate the bidding process for major weapon systems. Under this set of circumstances, the prices charged to the DOD for the products and services that it buys would more often than not be minimized by market forces despite the fact that corporate profits might well be maximized. Moreover, under this idealized set of circumstances, the likelihood that the various competing contractors

would invest in efficiency creating technologies and equipment would be maximized inasmuch as the market would "force" the harmonization of the price/productivity/investment continuum. Moreover, under this set of conditions, the DOD would have only a minimal need to develop and implement policies that attempt to minimize price while maximizing contractor productivity. The market would perform this function as price theory should.

VI. 4. FOREIGN BUYERS OF U.S. MILITARY GOODS AND SERVICES

This system does not exist for most DOD weapon systems acquisitions and especially for major weapon systems. This is due, in great part, to the culture that has grown up in the U.S. defense industrial base and the Pentagon, much of which is a logical outgrowth of the way in which the government wants to do business. The irony of this situation, however, is that an outcome similar to the ideal one described above is obtained to a greater or lesser degree by those foreign nations that resort to worldwide competition when acquiring weapon systems. By actively developing the expertise that allows them to become "knowledgeable buyers" (the practical and theoretical sine qua non for making price theory operable), these smaller nations have become able to induce some of the more salutary effects of Adam Smith's "hidden hand of enlightened self interest." This result has been obtained even by those foreign nations whose defense budgets are heavily tied to the U.S. defense industry because of foreign military sales credits, grants in aid, and other U.S. sponsored financial and economic incentives.

VI. 5. BUY "COMMERCIAL" VERSUS THE FOREIGN MILITARY SALES
APPROACH

Evidence of this can be found in the increasing trend by these countries away from the "stylized" foreign military sales approach and more towards a "buy commercial" process in which foreign nations deal directly with the U.S. defense industries for those equipments which meet their military needs and whose price is reasonably competitive when measured against worldwide prices for the same or similar products. Here it should be emphasized that the underlying pricing thesis for Foreign Military Sales (FMS) is a full cost approach, i.e., the recoupment of the average full cost of the unit or units of military equipment being purchased by the foreign nation.

By "going commercial" both in and outside of the United States and by acting as if it were buying the supplementary production of a contractor, the astute foreign buyer can often obtain a price that more fully recognizes its marginal as opposed to its full cost.

Even within the context of the FMS approach, there are nations such as Israel that have apparently learned to adopt a marginal cost strategy by refusing to buy the same package of goods and services otherwise purchased by the U.S. military departments. In this way, they force desired price (cost) reductions and obtain some of the cost savings ostensibly generated by longer or faster paced production runs.

The key irony here is that the small buyer may be better able to create a "competitive environment" within the U.S. defense industrial base than the U.S. government itself because

of the culture which has developed around the U.S. military acquisition process and because foreign buyers are not responsible for maintaining the U.S. defense industrial base.

VI. 6. PRODUCING AND NON-PRODUCING NATIONS

To better understand the irony of this situation and from it begin the derivation of a new pricing approach it is useful to posit the existence of two types of nations involved in the acquisition of weapon systems: producing and non-producing.

In the producing category in the free world, four nations predominate: the United States, France, Great Britain, and West Germany. Other nations do produce some of their military equipment and are even involved in the marketing and export of some of their military goods and services. However, for these nations, this is a peripheral activity, not a central one. Only the three countries noted above are major producers and exporters of military weapon systems. Moreover, only these four are comprehensively involved in these markets from the R&D phase through the "full scale" production phase.

In the non-producing category are all of the other free nations of the world plus virtually all of the third world nations. Thus, there are active buyers and active sellers of military equipment. These are the prerequisites for a marketplace to come into and remain in existence.

From the point of view of this analysis, the significant difference between the producing and non-producing nations is the commitment of the former to the maintenance of an indigenous,

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A NEW APPROACH TO THE PRICING OF MAJOR WEAPONS SYSTEMS

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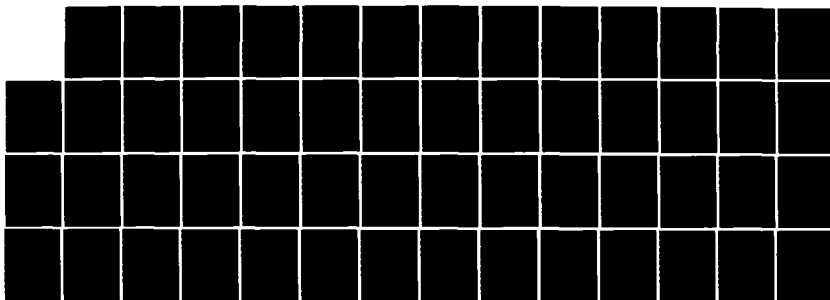
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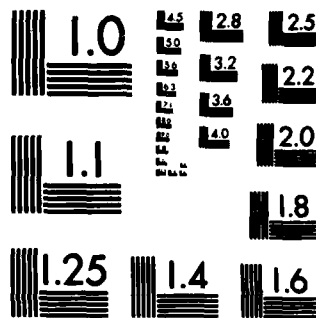
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full scale, militarily independent, defense industrial base. In practical terms, any commitment to the maintenance of an industrial base creates an implicit partnership between the manufacturer and the producing nation in which, among other things the responsibility for the creation of the supply side of the capital formation process is shifted from the seller to the buyer. This is the implicit quid pro quo for the implied partnership which exists in fact if not in theory. This partnership, in turn, creates an environment in which conventional economic theory (price theory) is only minimally effective. In our opinion, this is the crux of the problem with the pricing, profit, capital investment continuum in the United States. Put differently, conventional economic forces alone cannot and will not, in peacetime allow for the maintenance of a defense industrial base that is both putatively efficient and capable of being mobilized to meet a war time scenario. This is because the required regulatory procedures must then draw more from the tenets of welfare economics than pure price theory. This is the result of the fact that the maintenance by the government of redundant capacity is basically an income redistribution/subsidy process when pricing policies reflect an average full-cost practice.

Thus, if economic efficiency is the avowed regulatory goal, certain compromises in the size of R&D and industrial base maintenance activities have to be made. Where industrial efficiency is not the prime goal, price theory is necessarily supplanted by a modified version of an income distribution concept. A case in point is the current highly profitable position of the

U.S. automobile industry which was generated by protectionist of bail-out actions taken by the U.S. government.

Both the producer nations with whom we met, and even the non-producer nations, stated unequivocally that, ideally, they would prefer that competition be the basis for establishing the prices of the military goods and services they acquire. However, they almost uniformly stated that they could not afford domestic competition because it entails the cost of maintaining redundancies in their defense industrial base that are essential if intra-firm competition is to exist. The French representative, for example, stated that his country did not have enough R&D dollars available to support a less-than-rationalized defense industrial base. Because of this, the French are forced to spend more than 80% of their defense dollars on negotiated procurements. They adapt to this situation by building productivity measuring requirements into their defense acquisition process. They also recognize that these requirements may be modified by political goals such as a full employment economy.

In a different vein, the much smaller Israel has developed an R&D base so that it can develop equipment better geared to the military threat they face. An in-house R&D base also prevents a "brain drain" that the country can ill afford both economically and socially. In other words, they too have elected to spend a portion of their acquisition in order to accomplish a "social" as well as a military goal.

The essential lesson then for this project, in our opinion, is that the communal nature of the expenditure of government

funds must recognize the mandates both of welfare economics (the distribution of resources) and conventional economic theory (economic efficiency). This is because the expenditure of government funds inevitably involves the building of a consensus among constituencies with differing goals.

Thus, if a new pricing approach for major weapon systems is to be developed in the United States, it now seems evident that a practical compromise will have to be reached among the various constituents who control the flow of funds. Explicit recognition will have to be given to welfare considerations, an area, to the best of our knowledge, previously not discussed in any commonly used analysis of the defense acquisition process. It follows from this that if the defense acquisition process in the U.S. is ever to be harmonized with a set of national objectives that explicit priority will have to be given to one of the two competing theories of behavior. The least cost purchase of military goods may or may not, in the final analysis, be one of these goals.

VI. 7. WELFARE ECONOMICS

Where the essential economic goal of the defense acquisition process is purposively bound up in welfare considerations such as the redundant maintenance of a technological capability or job stability for specific personnel groups, then recourse to a full-cost pricing approach as a risk-reducing mechanism is essential. It is this approach that allows for the maintenance of ostensibly but actually redundant firms; the creation of labor intensive

firms to allow for the stockpiling of critical personnel; low capacity utilization rates and other so-called "excesses" built into the defense acquisition process.

More to the point, tying the defense acquisition process to redistributive considerations requires that profits be based on cumulative cost as opposed to the more desirable outcome in which cost and profit are otherwise unrelated. From a welfare perspective, there is no other capital formation technique available to the decision maker since the perceived need for redundant capacity and low capacity utilization rates would normally tend to suppress profit rates below required levels. Thus, in the welfare approach, profits are really a "return to equity" as opposed to the "return for risk" reward that they are held to be in conventional economic theory.

In practical terms, the WGLs convert the profit formulation process from a risk/return measure into a measure of "fairness", a concept firmly embedded in welfare theory. Where economic efficiency is a desired goal, a test of "fairness" or "equity" is irrelevant.

That said, it then appears safe to conclude that any policy which seeks to guarantee a minimum price based on average full cost, or to guarantee a reasonable profit based on some measure of "fairness" cannot and will not generate the levels of economic efficiency now being called for by the DOD. This is the situation which now appears to obtain with the largest of defense contractors.

VI. 8. THE USE OF MARGINAL COST IN PRICING

Based on our analysis, the only way that profits and costs can be dissociated in the defense acquisition process would be to create an environment in which there is an incentive for large contractors to adopt pricing policies based more on a marginal cost construct than now exists.

However, there are risks involved in implementing such an approach, particularly among the very large, or technology-critical contractors. Some of these risks need to be dealt with, e.g.:

- Business base: Because of the lack of a predictable business base, some defense contractors may find it economically and financially difficult, to bid on less than a full cost basis. The use of a full cost approach allows them to maintain a desired corporate capability irrespective of through-put and thus remain competitive in the long term. A marginal cost approach might obviate this ability. For these firms to be able to bid on a marginal cost basis, i.e., to fully recognize the need to be competitive across a broad spectrum of procurements and programs, the genuine use of multi-year contracts would have to be used. Moreover, the DOD would have to be actively concerned with the financial stability of the defense industrial base.

Some elements of German systems acquisition practice are potentially applicable here. In Germany profits on

(negotiated) defense contracts are limited to 5% of the sales value of the contract. As a quid pro quo for this profit cap, the German government actively promotes the use of fully funded multi-year contracts that guarantee the contractor an extended period of business stability. Here it should be noted that the bulk of German defense contractors have, according to the German military attache, substantial and profitable non-defense activities. Because of this, they can fully recognize the contribution to overhead and other fixed costs provided by German defense contracts and treat profits only as an additional incentive for doing business with the government. Business base considerations, then, become more important than profits per se.

- Contract Administration: Administratively, some guarantee against a sudden loss of the defense business base of a committed contractor would have to be provided for multi-year contracting to be effective. Although multi-year contracting would provide a contractor with some indemnification against business risk, program cancellation clauses would provide additional protection. This protection, however, cannot be "complete". Conceivably, then, some technique may have to be developed which retrospectively increases the price paid a contractor in the event that he is not able to maintain his business base because of unsched-

uled actions taken by the Congress, DOD or one of the military departments.

- The use of a marginal cost pricing approach assumes the existence of an extant business base. The use of this type of pricing approach might, by effectively limiting entry into the industry, force an undesired concentration of defense purchases in a very limited number of firms. Intriguingly enough, there is some evidence supporting the thesis that large prime contracts are being placed with fewer and fewer firms, i.e., that those firms that are defense specialists have, in effect, foreclosed the entry of other firms into the industry. The sole risk that the use of a marginal cost pricing approach may create is the loss of some surge capacity if a number of subcontractors now bidding for contracts drop out of the market. This loss is unlikely, however, because of the significant portion of most prime contractor's funds that are now being spent with subcontractors, material suppliers, etc. Just so long as the lower tier can increase its output, it is likely that the major contractors can expand the system integration responsibility that is now their key responsibility.

Moreover, from an economic perspective it is more than likely that these smaller firms will only partially

feel the full effects of the implementation of any new marginal costing approach. Most of these smaller firms are now exposed to pricing pressures from their primes and have likely adapted accordingly. As such they will be less prone to leave the market for defense goods than otherwise believed, particularly if there is no alternative demand for their output. Competitive pressures are never spread evenly in an economy.

- Notwithstanding the above, it is possible that those major contractors who adapt effectively to this pricing approach will earn profits in amounts that exceed the "fairness" thesis implicit in welfare economics. For a new pricing system to work, profit rates cannot retrospectively or prospectively be subject to federal review. The inherently American notion of "excessive profits" and "war profiteering" must be made unacceptable if any drive for economic efficiency is to be successful.

In addition to the potential for cost savings, one of the more significant advantages of a marginal cost approach to the pricing process is that it closes out the requirement that the need for the DOD to establish, implement and monitor profit and other related policies designed to support a multiplicity of national goals. Under a marginal cost approach, profit becomes the true risk-return transaction that it is supposed to be.

Moreover, those firms who truly desire to compete will be under pressure to become more efficient since there will be neither a negative nor a positive constraint on their profit making capabilities.

VI. 9. THE FULL COST THESIS

The full cost thesis gets established in the defense contracting process by the formal ratification of an overhead cost structure, which then gets translated into a relatively routinely quoted and used overhead rate on defense contracts. Although there is a retrospective review of these rates, with downside or upside adjustments factored in, the reality of the rate and the industrial behavior that it then allows or mandates, gets built into what we have referred to as the acquisition "culture". This culture dictates that firms do not, in fact, reach for significant economies of scale by spreading certain relatively fixed costs over a larger level of output. This is an excellent practice if the tenets of welfare economics are to apply, i.e., income redistribution, equity or fairness, base maintenance activities.

It is a poor practice if economic efficiency is to be the dominant virtue in that it locks all price setting exercises into an average full cost thesis which by its very nature does not require the control of all corporate costs.

In a full-cost thesis, the bidding process tends to take on an aura of what the market can afford as opposed to what the

market should pay. This is not a play on words. The problem is a real one and reflects an acquisition culture which has evolved over the years. Part of the culture is the result of the use of the legal construct that doing business with the government is not a right but rather a privilege and that, as a quid pro quo, the government is responsible for paying a "fair" price for whatever goods and services it buys. In the absence of a market price, the government has defined a fair price as the average full cost of those goods and services it buys. Where there is a goal of economic efficiency a "fair price" is irrelevant in that its determination establishes a barrier to the unfettered operation of the marketplace by suggesting that the government will pay a higher price than may otherwise be necessary. The "defense game" is often played against the "how high a price I can get" construct as opposed to "how low a price is" for both the buyer and seller.

No logical businessman will, of course, argue with a full cost thesis if it is promoted by his buyer since he desires to maximize the price he receives for his products. This is particularly true if "competition" takes place in a market where there is little potential for playing the elasticity of demand game. Because of Congressional funding practices, the lack of an elasticity of demand factor is explicit in the system acquisition process.

Any new pricing approach to be effective must take into account an elasticity of demand factor by giving the businessman a logical incentive to bid after additional business with extreme-

Any new pricing approach to be effective must take into account an elasticity of demand factor by giving the businessman a logical incentive to bid after additional business with extremely high profit potential. The current system neither calls for nor allows the defense oriented firm to actively pursue an elasticity of demand approach to its strategic planning process.

It is this reality that we believe needs to be built into the systems acquisition process if a new productivity-oriented pricing approach is ever to be implemented.

Unlike the current situation for most large contractors, price must be allowed to play an even stronger role in clearing the market than it now does.

CHAPTER VII

MARKETING CONSIDERATIONS, CORPORATE STRATEGY AND THE PRICE, PROFIT, INVESTMENT CONTINUUM

VII.1. Introduction

One of the major problems blunting any DOD attempt to bring about price reductions and capital investments in the prime contractor element of the defense acquisition process is the significant differences in the marketing of defense goods as opposed to private goods and the impact this has on the organization and operations of the industry.

For conventional price theory to be effective, the businessman must be able (a) to perceive a need for a product, (b) to establish reasonable parameters on the price at which the product will sell and the cost to produce it, and (c) enter that market subject only to the constraints that his product quality and price satisfy the customer. Where he properly perceives the need for a product which he is capable of producing and marketing, the major constraints he has to overcome are internal to the organization of his own company. In this context, he does not have any externally imposed barrier he must surmount other than that of competition. Although he must choose his corporate strategy carefully, virtually all of the decisions he must make are within his control. Moreover, and this is perhaps the most critical issue of all, he can regard the demand side of the capital formation process as automatic. His targeted buyer will find the capital to purchase his product if the demand for that product is real.

Virtually none of these conditions exist in the defense arena because of the "artificial" nature of the systems acquisition process. For example:

- First, the demand side of the capital formation process is never "guaranteed". The setting aside of the funds needed to buy a weapon system is subject to constant review and, potentially, rescission both by Congress and the DOD. Not until the process for a specific weapon system has matured (generally not until a prime contractor has been granted a virtual product monopoly) is the relevant portion of the business base of the producing firm reasonably well guaranteed, albeit with little or no stability. Because of the funding process, the defense contractor neither controls nor dominates his market, or his marketshare, as is implicitly assumed in conventional price theory. The control decision is external to the corporation and/or its competitors. Moreover, the defense contractor can rarely if ever manipulate demand upwards by modifying his pricing strategies.
- Second, once a contract has been awarded to a competitor, the losing firm is for all practical purposes barred from the marketplace for that particular good or service. The losing firm cannot then gain entry by offering a better product or better price except

possibly at some discreet point in the future when competition is opened to a second source. Even then, there is no guarantee that the losing firm will in fact be allowed to compete. If the losing firm chooses to remain in the marketplace, it must then "stockpile" the people needed to maintain that capability and, then, once again "bid the company" against a new requirement.

This is somewhat in contrast to the market for private goods where there may be only winners. Although some winners may, and do in fact, control more of the market than others, a number of winners can survive. The automobile industry is a good example here.

- Third, because he can neither define nor control his portion of the marketplace, the typical prime contractor must be prepared to maximize his marketing or sales capabilities over a broad range of goods and/or services. To do this, however, the typical prime contractor must stockpile "technological capabilities" that allow him to be at least potentially competitive in a broader range of markets or sub-markets than would otherwise be necessary were it possible to have more than one winner. This is the result of the fact that the DOD asserts for itself the right of "consumer sovereignty" and "consumer choice" in that it decides in a discontinuous manner what products will be bought.

This is reasonably consistent with conventional economic theory. The inconsistency endemic to the defense industries is that what may be produced may never be bought beyond the full scale development phase. The transition to full scale production is always problematic and particularly so when there is a large "bow wave" of programs waiting to go into production. Moreover, the reality of consumer sovereignty is stretched to a breaking point by the fact that the buyer asserts his full responsibility and/or ability for specifying all of the technical features of the desired product. Because of this, the businessman loses control of yet another element vital to his proper management of the industrial organization for which he is responsible, once again blunting the full application of price theory to the purchase of defense goods and services. Because he cannot specify the product, and because he cannot control changes to it, he must constantly behave as if he were managing a job shop and not a production line. In a job shop type of operation, a full cost pricing approach is essential to long term economic survival. The potential for a marginal cost approach is minimized except where prices are used to offset an unacceptable loss of market or, more often, to keep a facility open during periods of economic stress.

In sum, the marketing context in which major systems are now produced does not allow for total reliance on price-oriented economic behavior. Modifications to corporate strategy are necessary. Indeed, the underlying dynamics of the acquisition process appear to force both the government and industry into adopting, without so saying, some of the theories and practices of distributive economics.

Indeed, there is an interesting and cogent conundrum here. To the extent that the DOD sustains some, if not all of the otherwise excess capacity of the loser -- and pays for it in higher product costs when the loser becomes a winner -- the implicit use of a sales allocation process for certain elements of the defense industrial base makes goods economic sense. But this "good economic sense" is inconsistent with a price-oriented drive for economic efficiency.

The underlying problem from the affordability perspective is the general reluctance of prime contractors to reduce their business base except as they are consistent losers in the bidding process for defense contracts. In defense, bigger is better because of the market segmentation possibilities it provides.

VII. 2. MARKET RESPONSES

Before beginning the outlining of a new approach to the pricing system process, we believe a note on the organization of the airframe industry may be relevant.

From a very pragmatic point of view, there are no single manufacturers of jet aircraft in the United States. Instead

there are combines of firms who can and do pool their resource under the aegis of a prime contractor. Commercially, Boeing's 757 and 767 is a classic case in point.

Combines serve two key functions. First, they spread the developmental and business risk over a great number of firms. No one, except possibly the prime in the instance of Boeing's 757 and 767, is required to "bet the company" on a new product.

Second, and perhaps more important, the existence of combines mute the effect of competition within an industry; no one firm is expected to exit the industry because of the loss of a contract. Prices, in effect, become cartelized by the existence of combines. Thus, even in the commercial world, allocative processes exist and function although in a very limited number of industries. In the case of aircraft, these costs are ultimately passed on to the consumer through the airlines in the form of higher fares. Since aircraft, in this instance, are a "derived demand" product, the more critical factor for the producer of commercial jets is the willingness of the air traveller to foot the bill.

These self same combines also exist for the production of military aircraft though possibly not in as pronounced a manner as in the case of commercial aircraft. Combines are a logical strategy for aerospace firms to pursue given the nature of the defense market discussed earlier. Everybody can become a winner by being prime on some contracts and a subcontractor on others. However, as also discussed above, it forces all of these firms to retain a greater technological capacity than they otherwise might

maintain were they better able to control or manage their sales base.

The net result of this inability to manage a sales base is a product cost far in excess of what it might otherwise be as the cost of one excess capacity is pyramided onto the cost of other excess capacities. At issue, then, are techniques for legitimately reducing this excess capacity and the costs associated with it.

In this regard, an adaptation of French pricing practices for joint ventures has merit. French practice does not allow the combine manager or, in our terms, the systems integrator, to load his fully-allocated costs on to that of other members of the combine. Instead, each of the units of the combine or joint venture is treated as a separate but combined sales and profit center. In sum, charging overhead on prior layers of overhead is disallowed, or, at worst, actively discouraged. An adaptation of this policy may, in the context of our growing "systems integration industry", make sense in the United States and particularly so where it can be demonstrated to Congress by the DOD that some elasticity of demand for specific products can be created by the more astute management of de facto combines or joint ventures.

VII. 3. MARKET STABILITY AND MARKET POWER: REGULATORY CONCEPTS

If our analysis is correct, the one element essential to the development of any new pricing approach within the defense industries is market stability. This is, in our opinion, a particular requirement for the very small number of large defense

contractors whose function is heavily bound up in what is commonly referred to as the systems integration process. Although developing a new approach for a small number of firms may be regarded as showing favoritism to the "rich and powerful", the incontrovertible reality is that there are a small number of firms, who, because they control the bulk of our defense dollars, drive the economics of the acquisition process. For these firms, the availability of a properly negotiated multi-year contract may be the most powerful of all tools available to the DOD. This is subject to the caveat that any multi-year contract be structured to minimize the monopoly power otherwise granted to the producers of major weapon systems.

The key word here is "monopoly". In point of fact, only one firm can make an F-14 aircraft, and only one firm can make an XM-1 tank. Similarly, only one firm can make many of the high technology missiles that are now their central business domain. Because of the way in which the Full Scale Development and Production Phase of the acquisition system is organized, firms that make these equipments do in fact have product monopolies that often extend out to 20-25 years because of the long service life of many military products. Moreover, the grant of monopoly rights extends well beyond the grant on the weapon system per se. It extends also to the spare parts and other life-cycle support procurements. Critically, other than the ineffective vagaries in the funding process, there is no DOD policy or practice that is designed to deal directly with this monopoly power, if indeed it has ever been recognized as such.

Thus, for any new pricing approach to be effective in constraining cost and inducing capital improvements in the defense industries, it must be able to properly accommodate to this monopoly power. It must do this by enforcing a set of financial and economic constraints on that monopoly power that grant explicit pricing, cost and investment authorities back to the government. One of these authorities is a modification of the use of the average full cost thesis as it applies to all weapon system procurements. Many discussions of the DOD-Defense Contractor relationship have referred to it in terms on monopsonies and monopolies as is here being done but without recognition that the control of such a relationship cannot rely on price theory but must look to a welfare economics-oriented construct. In this instance, some form of routinized regulation must be considered.

Here it must be recognized, public perception to the contrary, that the annual funding process mandated by Congress does not diminish a defense contractor's monopoly power. In fact, by interjecting an element of instability into the business planning equation, the annual funding procedure may promote the use of the type of defensive strategy by a prime contractor that is, in effect, economically vindictive if not venal. In our opinion, the annual funding cycle allows a contractor to state, on an annual basis, what he will then produce based on his knowledge of the money available for his program. Unit cost, then, becomes a function of available funding as opposed to the other way around. The annual funding process then funds the full costs of whatever

corporate strategy that a monopoly-based firm is the pursuing. In economic terms, the annual funding process allows the monopoly-based seller to extract an "economic bribe" because of the political process in which all major procurements are negotiated.

Stated DOD policies and procedures quite properly cannot and do not take direct account of the political process but, unfortunately, at a high cost to the taxpayer because of the power that this blind eye to politics grants the defense contractor. Couched in more cogent military terms, the DOD cannot refuse to buy a major weapon system for which it has stated over a long period of time that there is an explicit force structure and doctrinal need. Over time then, its bargaining position is weakened and especially so if a system is in or close to being into full scale production. In effect, the monopsonistic power that analysts say DOD has is substantially diluted as the political support for a program grows. At some point in time, the annual funding process notwithstanding, the DOD is forced to play the dollar game as the prime contractor sees fit. There is no relevant economic explanation for this shifting of the sands except to say that this is the "nature" of any monopoly or cartel-like economic structure.

The problem then boils down to an overt admission that conventional price theory is irrelevant and inapplicable to the acquisition process for most major weapon systems and that a hybrid approach consistent with the hybrid nature of the acquisition process is essential.

At issue in our opinion is an overt recognition (a) of the de facto grant of monopoly power and (b) the need for a negotiated quid pro quo which overtly gives back to the government certain price, cost, and marketing authorities.

This can be accomplished, we believe, by linking multi-year contracts to a predefined, productivity-oriented, cost reduction program. We have termed this "Business Base Planning", as discussed in the section that follows.

VII. 4. BUSINESS BASE PLANNING

One technique for reinforcing the government's authority vis-a-vis the monopoly that its actions have created, would be to grant a multi-year contract with prices established up front for each of the years of the term of the contract subject to the provision that there be a steady, year by year, inflation-adjusted decrease in the unit cost of the product being procured. Moreover, these cost increases should be the result of an agreed upon and pre-planned reduction in specific, direct and indirect costs, associated with a program. This, in effect, would introduce a modified marginal cost concept into the pricing process but use a Business Base Planning process as the medium. It would do this by routinely decreasing the size and extent of the cost pools assigned to a specific contract.

The rationale here is straightforward. As production-oriented programs mature, they should be able to operate with a planned and measureable reduction in associated management, engineering and other costs. By agreeing to stabilize the

business base of several large firms for a period of years, the DOD should be guaranteed some specific input and/or control over the overall cost structure of its very large prime contractors. Put another way, once into full scale production, large prime contractors should not be allowed to pay for the stockpiling of people and/or resources with the funds provided by large production oriented programs. These programs should be thinned down as quickly as possible with new income-generating contracts or business used to guaranteed employment for the resources so released.

As a quid pro quo for a predictable and extended business base, defense contractors should be expected to rely solely on their own internally-generated resources for the implementation of any broad based corporate development or marketing program.

Because this is an overtly regulatory approach to price containment, its procedure is inconsistent with competition-oriented price theory. In a sense, this procedure is no more and no less than an adaptation of welfare economic theory and practice, the theoretical subset that now dominates the business practices of most major defense contractors. In that regard, it is consistent with the overriding culture of the major systems acquisition process and the monopoly-like powers granted to a firm once a major weapon systems program goes into full scale production.

By Business Base Planning we mean a price negotiation process which ties cost to the production life-cycle, e.g., 100 aircraft per year for five years, or six or whatever the planned

buy may then be. This approach assumes that the inflation-adjusted cost of these aircraft should decrease over time and, by being properly scheduled for a predictable period of time into the future. There are, however, two elements to the cost reduction process.

1. The first is the reasonably well understood "learning curve" as it impacts on the amount of production line labor and material needed to produce a specific product. Over time, and assuming that a plant is running at a reasonable percentage of its full capacity, production-related cost savings should occur. We say should because learning curve cost savings cannot be achieved on a slow moving, low output production line. Learning curve theory generally assumes relatively fast paced, substantial production runs with a great number of closely-cycled repetitive functions. Not all defense production meets that requirement.
2. Second, and more important in our opinion, are the non-production line costs directly related to the manufacture of certain products. These overhead-type costs should decrease over time as many technical and managerial problems mature and are solved. In the absence of any overt competitive or regulatory pressure, these costs tend to remain stable, but with an upwards bias. It is with this latter group of costs

that Business Base Planning should be most concerned,
i.e., with the phased reduction in allowable overhead costs as a production-oriented program matures in order to move back towards a marginal cost approach to the pricing process.

The DOD now has no technique for enforcing the outcome set out in (2) above. We are suggesting that it be granted that authority in conjunction with a multi-year contracting authority as a way of inducing cost savings on major weapon systems. To do this, it must look at a broader range of costs than it is now allowed to do.

Specifically, it must be allowed to require a contractor to submit for approval an extended business plan that delineates relevant overhead costs and rates consistent with the quantity being scheduled for these years and which further establishes a plan for the phased reduction in all program support costs.

Where there is no evidence that these costs are being methodically reduced consistent with the production line maturation process, the DOD must be granted the authority to adapt its negotiating strategy from a previously known starting point, e.g., the prior overhead history of a company or division of a company.

We are not suggesting that the learning curve be ignored but rather that a similar and pre-defined "learning curve" be determined for the entire business base needed to produce a given product.

In very simple terms, we are suggesting that productivity improvements be expected both on and off the production line, and that these be negotiated before the fact as a quid pro quo for a multi-year contract.

In the absence of viable competition, there is no way of forcing productivity enhancing improvements other than to build in to a negotiated contract a predetermined level of cost savings based on the production and managerial maturity expected of a program.

VII. 5. WELFARE ECONOMICS REVISITED

None of the above is consistent with the application of conventional price theory. They cannot be since the acquisition of most major weapon systems cease to be non-competitive once the initial full scale production contract is placed. Cost and price control, after that, becomes a regulatory process unrelated to the market clearing process that is price's key function. Where prices cannot be competitively constrained, the only available alternative is to mandate cost control.

We see no other possible approach to the pricing problem. However, consistent with price theory formulations, we are suggesting that the risk burden be placed back on the contractor after year-one by requiring specified cost and price reduction goals. These goals should be identifiable and measurable, e.g., groups of resources and/or people. If the contractor misses the cost reducing goal, he should be forced to sacrifice profit. Con-

versely, if he meets the goal or exceeds it, he should be allowed to generate as much additional profit as he can.

To further shift the pricing burden to the contractor, a benchmark profit goal should be established for only the first year of a contract. After that, profit rates should not be negotiated. Since the out-year contracts are using then become, true fixed-price contracts, the profit on a contract should then be whatever residual the contractor can manage between the price he has bid and whatever he may have predicted his future costs to be. The contractor, not the government, should determine and control these levels subject only to normal business risk. The use of fixed-price contracts in this context is the only technique we now know that can meet the decision rule specified earlier in this report, i.e., a pricing approach based to a greater degree on marginal cost concepts.

VII. 6. BUSINESS BASE PLANNING RISKS

The risks inherent in this approach are two-fold:

- That a key contractor will refuse to negotiate on more than an annual basis on the assumption that he is the "only show in town" or,
- That he will refuse to accept the business base discipline inherent in setting out and meeting the cost reductions procedures he must identify and implement on a year by year basis.

There is no logical response to this type of conflict except, unfortunately, the show of political will that allows the DOD to shut a contractor down by refusing funding and, in so doing, force a bankruptcy.

Monopoly power is never benign and should not be regarded as such. This is the risk that always exists when a firm is granted monopoly-like power. Here the only effective action a buyer can take is to either forego the purchase or accept a substitute.

This is a difficult task when force structure and doctrinal considerations are factored into the negotiation process but it is a task that needs to be faced if the cost of major weapon systems are to be controlled efficiently enough to maintain a defense-oriented concensus in the United States.

VII. 7. REGULATION

In sum, we are saying that the defense industries need to be regulated but in ways which are consistent with the form of economic structure and behavior that they have adopted.

To attempt to apply conventional price theory to an industrial structure that is non-adaptable to price theory is, in our opinion, a futile exercise.

The more appropriate action is to recognize the need for regulation, and implement those procedures most consistent with the structure of the industry and the outcomes expected of it.

VII. 8. UNLINKING PROFITS FROM COST

There are two and possibly three ways to unlink profits from underlying cost:

- To base final price on some return on investment (ROI) construct.
- To base final price on some return on assets employed (ROA) construct.
- To relate profits to some kind of cash flow construct.

The primary rub with each of these approaches is that they would simply substitute one regulatory procedure for another. There is no marketplace measure that can be invoked in the defense sector whose outcome would be automatic, i.e., the result of pure market forces and thus consistent with price theory.

That said, the ROI (equity) measure would, in our opinion, be the better approach if it were tied to some long-term normative measure on the need for maintaining a viable, financially healthy defense industrial base. However, once again even this normative judgment flows from a regulatory concept which, ultimately, is essential because of the government's role in creating the demand for the output of the defense industrial base.

Unlike any other subset of the U.S. economy, in the defense industry, the DOD is the buyer who is ultimately responsible both for the demand side and the supply side of the capital formation price. That is the major rub in any attempt to rationalize the supply/demand and pricing relationships in the defense industrial base. Since it is responsible for both sides, the buyer should assert this authority by regulating the size of the supply side

investment made in the maintenance of a corporate capability that is not directly responsive to its needs.

VII. 9. GENERAL DISCUSSION ON THE BUSINESS BASE PLANNING APPROACH

- As a quid pro quo for a multi-year contract, the prime contractor is being asked to implement a planned reduction in the size of his workforce and/or his future technological capability except as he can find new paying work for these resources. This may be inconsistent with the principle that one of DOD's key functions is to push technological developments in the U.S. As with leader-follower or second source competition, this may lead to a division in the defense industries between those firms that are R&D-oriented and those that are production-oriented. The costs and benefits of this outcome have never been debated. From a purely economic point of view, the result might be salutary in that it recognizes the life-cycle realities of any product line and a possible beneficial recognition of a division of labor concept in an otherwise hybrid industrial structure.
- It may force a permanent shrinkage in the size of many of the large firms that are primarily defense-oriented and cause shifts in employment out of the defense

sector at a time not desired by the government. This, however, can be "controlled" by the government by modifying IR&D and B&P cost allowance procedures.

- The Business Base Planning approach requires that the DOD actively link the acquisition process to defense industrial base considerations. To do this, it needs a different set of managerial skills than it now has.
- The business base approach assumes, perhaps incorrectly, that a more manifest control over the macro-economic business practices of 20 to 30 very large defense subcontractors will spill over to the 4000-6000 second and third tier subcontractors on whom this smaller number of large companies rely.
- As noted earlier, this approach still does not solve the problem of unlinking profits from costs except as an equally artificial method such as a negotiated return on investment or assets is used as a surrogate. Except where genuine competition between two or more suppliers can be implemented, the government has no choice but to negotiate profit rates except as, in the German model, where it establishes a profit rate that it uniformly applies to all negotiated contracts.

- One potential offset to this regulatory procedure would be to allow target profit rates to increase over the life cycle of a major procurement as desired cost reductions are realized. In no event, however, can the determination of profit rates be left to market forces simply because there are none when contract negotiations are entered into with a firm with a critical product monopoly.

VII. 10. SUMMARY

In a sense this report has suggested that there is no such thing as a new approach to the pricing of major weapon systems except as the need for new regulatory procedures are perceived.

Basically, the report is saying that market forces cannot be relied upon to constrain the cost of major weapon systems because of the economic hybrid that the system acquisition process has become and, most likely, will remain.

Similarly, we are saying that there is no market-oriented way to unlink profits from costs for major weapon systems. The unlinking can only be created by substituting one regulatory measure for another.

In sum, the report is saying that the defense industries are unique and that unique forms of regulatory procedures are needed if the prices of a major weapon system is to more fully reflect its better controlled underlying cost structure.

Schematic Representation: Productivity Issues

The following exhibits provide a schematic representation of our findings. Although the Project Plan called for a summarization of our findings in matrix form, on completion of our analysis it became obvious that the rectangular array implied in the term "matrix" was not suitable for illustrative purposes. Because of this, we have adopted a pyramidal model which we believe provides a better conceptualization of our analysis and findings.

Exhibit I shows a simplified, three-tiered structure of a productivity model. At the apex lies the main goal: a boost in productivity. Although more recent discussions recognize that a boost in productivity can be induced by such factors as improve product quality, accelerated delivery schedules for inventory and subcomponents, and worker job satisfaction, we are limiting our discussion to productivity increases that result in the unit cost savings that are the primary focus of our study.

The second tier of the pyramid displays those factors commonly associated as contributors to productivity gains. Although there is some hairsplitting among analysts as to what factors appropriately belong in this group and how much weight each should be accorded, six of the more "stand-

ard" elements have been listed, i.e.,

1. Changes in Management Practices
2. Economies of Scale
3. The substitution of capital for labor as mathematically depicted in the Capital-to-Labor Ratio.
4. Advances in R&D (application of new technologies)
5. Composition and Volume of Output
6. Composition of the Workforce (age, experience, education, etc.) of the labor force.

Finally, the third tier of this pyramid is comprised of those DOD policies which are designed to stimulate productivity by acting on second tier factors of production. There are a large number of DOD and Federal actions designed to improve productivity, we have listed only those discussed in this report. They are:

1. Weighted Guidelines (WGLs)
2. Profit Policy
3. Contract Incentives
4. Tech-Mod
5. Buy-Backs (Termination Indemnification)
6. Depreciation Policy
7. (Other)

In the absence of distorting influences, the model set out in this schematic should operate smoothly. The policies

set out in the third tier should stimulate one or more of the second tier contributors which, in turn, should translate into measurable boosts in productivity. The reasoning behind DOD's Profit Policy, for instance, is sound. Efforts designed to increase the ability of contractors to alter the capital-to-labor ratio should be translated into a net boost in productivity.

Unfortunately, distorting influences do exist. Exhibit II displays the first juncture at which the model can break down inasmuch as a decision making "filter" exists at the level of the individual firm which can block in part or in full the inherent effectiveness of these policies. In other words, even if DOD and other policies are perfectly designed, the various decision making barriers that exist at the level of the firm can frustrate their implementation. We have listed eight such filters, although there are many others (Filter I):

1. Desire to Remain Labor Intensive for Flexibility
2. Interest Rates
3. Pay-Back Periods
4. Business Base or Program
5. Costs of Doing Business with the Government
6. Incompatability with Existing Manufacturing Processes
7. Paperwork and Elaborate Implementation Procedures

8. Unawareness by Top Management of Contract Type and Contract-Specific Incentives

Exhibit III displays the second juncture at which the model can again break-down. Even where the policies at the bottom of the pyramid succeed in motivating individual firms to seek after productivity gains, there is still the possibility of failure. This is due to the (second) filter which exists outside of the individual firm but to whose realities the firm must be responsive. In other words, there are a large number of economic and acquisition related variable which can mitigate against productivity increases even if the operative policies are successful in reaching their first-order consequences. We have cited six components in Filter II for illustrative purposes only. They are:

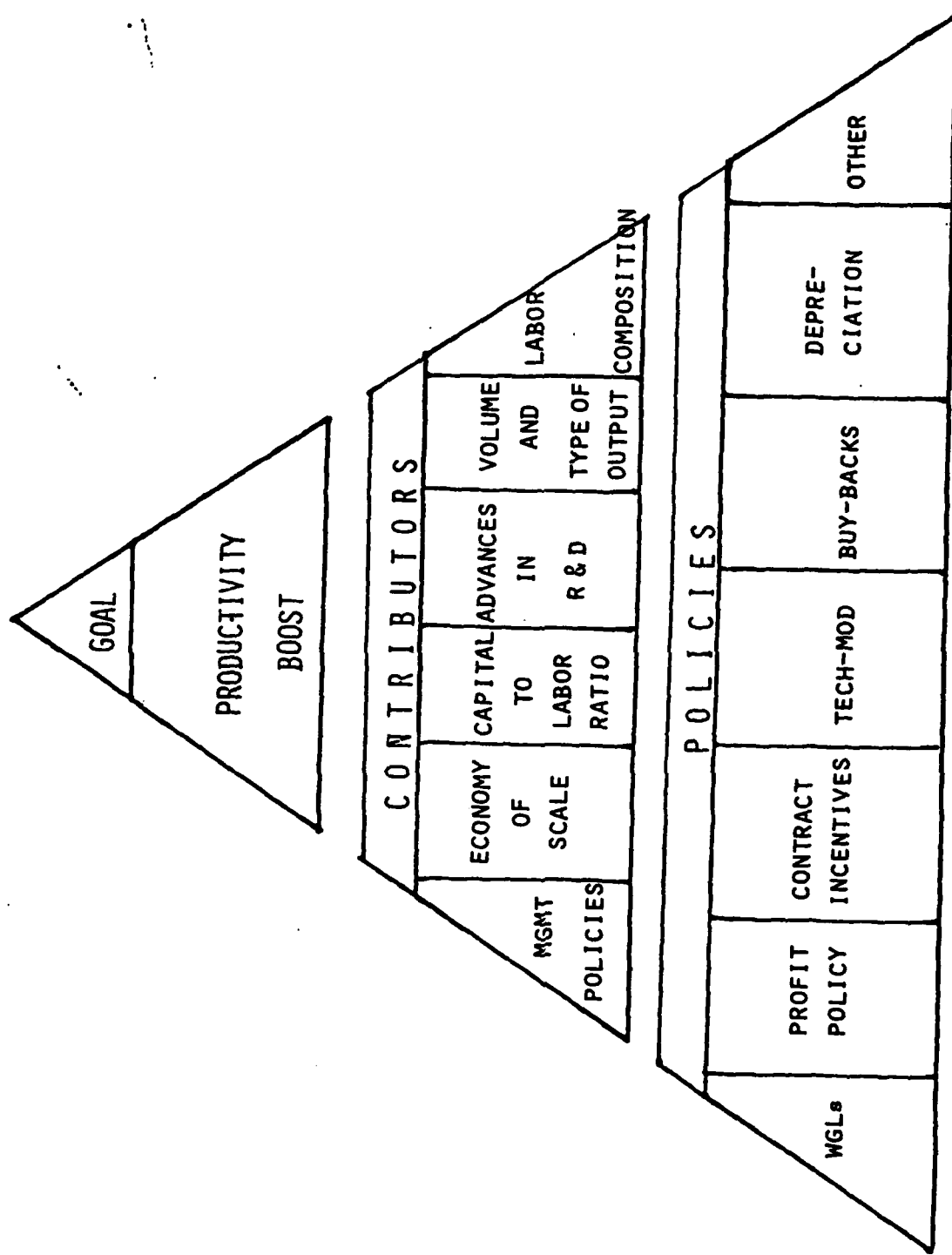
1. Systems Integration and Overhead Layering
2. Redundant Capacity and Low Utilization Rates
3. Divided Attention between Commercial and Military Markets
4. Small Contribution of Touch-Labor to Total Costs
5. Economic Cycles (Recession, Expansion, etc.)
6. The Annual Funding Process
7. (Other)

It is our belief that the central problem with existing DOD efforts to boost productivity is that they fail to adequately address these filters. From our review of the

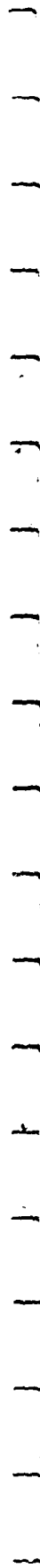
literature, it appears that there is a growing sensitivity towards those elements in Filter I. The longstanding belief that contractors place short-term profits above all other business considerations is now being challenged. Some progress is being made to tailor certain policies to other corporate concerns.

However, in our opinion, the impact of the second filter on productivity enhancing investments has not yet been adequately recognized. Achieving a small increase in productivity on an ad hoc basis at one firm or another is, however admirable, inadequate systemic changes are needed inasmuch as the production inefficiencies associated with larger industrial issues set out in Filter II will dwarf any gains made on the manufacturing of one component of one program.

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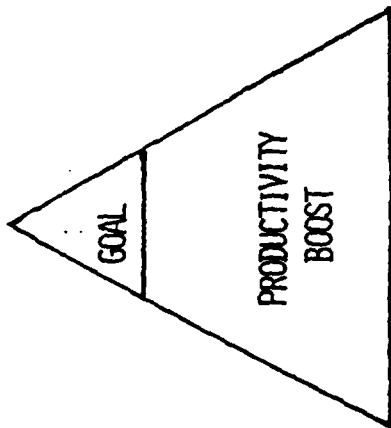


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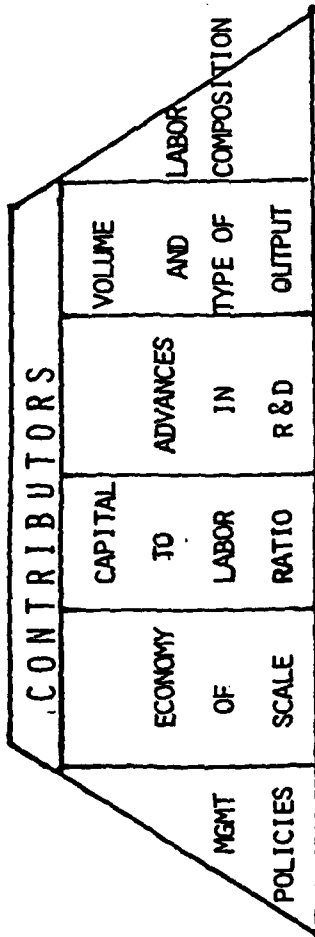


FILTER II

1. Systems Integration - & Overhead Layering
2. Redundant Capacity/ Low Utilization Rate
3. Divided Attention Between Commercial & Military Markets
4. Small Contribution of Touch-Labor to Total Costs
5. Economic Cycles
6. The Annual Funding Process
7. Other



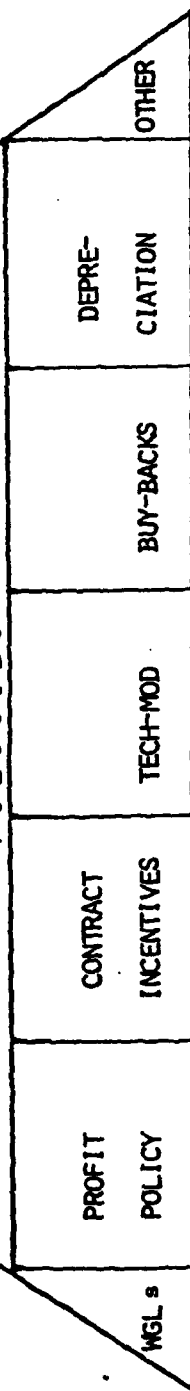
FILTER FILTER FILTER



1. Desire to Remain Labor Intensive for Flexibility
2. Interest Rates
3. Pay-Back Periods
4. Program Instability
5. Costs of Doing Business with the Government
6. Incompatibility with Existing Manufacturing Process.
7. Paperwork & Elaborate Implementation Procedures
8. Unawareness of Contract Type by Top Management.

FILTER FILTER FILTER

POLICIES



OTHER

Schematic Presentation: Economic Theories

As discussed in the body of the report, economics is not a "hard" science. Indeed, it is probably not even a science but a way of coherently explaining sets of behaviors or sets of outcomes.

Notwithstanding the above, there are two basic types of economic theory:

- Price Theory or the "conventional" perception of economic behavior in a market oriented, free economy.
- Welfare Theory or economic behavior as it is practiced by regulated monopolies.

It is our contention that the bulk of major weapon systems programs are carried on in an environment which more closely mirrors the tenets of welfare as opposed to price or conventional economic theory.

The implications of this statement for profit policy (capital formation) are critical as they are for the desire and/or ability of the defense contractor to invest monies in new equipments, technologies and/or management systems.

Some of the differences in these two bodies of thought are set out in Exhibit I. The list, once again is meant to be illustrative as opposed to comprehensive.

In our opinion, the difference between the perceived behavior of the defense industries and the actual behavior (price vs. welfare theory) is one root cause for their ultimate non-responsiveness to many DOD related productivity enhancing efforts. We do not believe that the defense industries will be fully responsive until incentives are more closely tailored to the set of "economic rules" to which they have to tailor their behavior.

That is the summary conclusion of this report.

CONVENTIONAL PRICE THEORY

APPROPRIATE WHEN:

- A NATURALLY COMPETITIVE MARKET EXISTS FOR TANGIBLE GOODS AND SERVICES
- NO SINGLE BUYER OR SELLER CAN INFLUENCE THE OUTCOME OF THE MARKETPLACE. PRICE IS SET BY THE MARKETPLACE.
- NO SOCIAL OR POLITICAL NEED FOR MAINTAINING EXCESS OR REDUNDANT CAPACITY.
- BASE SUPPLIES, SPARE PARTS OR LOWER ACAT CATEGORY GOODS ARE BEING PROCURED.
- A SUPPLY/DEMAND RELATIONSHIP EXISTS OR CAN BE MADE TO EXIST (ELASTICITY OF DEMAND).
- PROFIT MARKETPLACE DETERMINED.
- NO DIRECT RESIDUAL RELATIONSHIP BETWEEN PRICE AND COST.

WELFARE ECONOMICS THEORY

APPROPRIATE WHEN:

- A CONTROLLED MARKETPLACE EXISTS (MONOPSONY, MONOPOLY, UTILITIES)
- WHEN DETERMINATION OF PRICE & PROFIT CANNOT BE MADE SOLELY BY THE MARKETPLACE.
- WHEN PRICE IS NOT THE MOST IMPORTANT FACTOR IN THE PURCHASE OF A PRODUCT
- WHEN LARGE EXTERNALITIES EXIST AND MUST BE COMPENSATED FOR IN THE PRICE CHARGED FOR GOODS AND SERVICES (INCOME REDISTRIBUTION EFFECTS)
- MAJOR WEAPON SYSTEMS (HIGH-COST, SYSTEMS-INTEGRATION-ORIENTED) ARE BEING PROCURED. THE USE OF DEJURE OR DE FACTO INDUSTRIAL COMBINES.
- PROFIT NEGOTIATED OR REGULATED.
- NEGOTIATED RELATIONSHIP BETWEEN PRICE AND COST.

Glossary of Terms

The following are some definitions of terms commonly used in this report. Except where otherwise noted, all definitions have been taken from the Dictionary of Business and Economics, compiled by Christine Ammer, (Free Press; MacMillan, Inc., 1984).

Average Cost

1. A cost accounting technique in which either purchased material or production costs are averaged to determine the cost of goods sold. It is used in industries where costs of individual lots tend to vary erratically and reported profits become more consistent and meaningful if costs are averaged. For example, if out of 50 units of goods stocked in inventory, 10 units cost \$100, 15 units cost \$200, and 25 units cost \$350, then the average cost per unit would be $(\$100 + \$200 + \$350) \div 50 = \13 .

2. Average Cost Pricing. Also, Full-Cost Pricing. A technique of pricing goods for sale whereby the price is based on both average fixed and average variable costs divided by the quantity of goods being sold. Since costs tend to decline as output increases, the price usually also declines. From the seller's viewpoint, therefore, average-cost pricing is useful only when sales volume is fairly predictable; otherwise, if sales are lower than expected, the price will not yield the seller a profit (or perhaps even enough to recoup costs).

Major Weapon Systems (Author's definition)

High-cost, heavily system-integration-oriented defense projects. In DOD parlance, these are often referred to as ACAT I projects (Acquisition Category One) requiring inclusion in the SAR (Selected Acquisition Report) and costing in the hundreds of millions or billions of dollars).

Marginal Cost

The addition to the total cost of one extra unit of output. Owing to the economy of scale, most manufacturing industries benefit from reductions in unit cost as their volume of output increases. However, this pattern does not continue indefinitely and eventually marginal cost begins to rise (owing to the use of less efficient input). On a graph, therefore, the marginal cost curve is generally U-shaped.

Marginalist School

Also, marginal utility school, neoclassical school. A group of economists whose ideas dominated Western economic thought from the 1870s to the 1930s, first replacing classical economics and then being considerably modified by Keynesian economics. The name comes from their emphasis on the concept of marginal utility, which they used to explain many economic phenomena. Unlike the classical school, the marginalists believed that demand is the primary force in determining price, and that demand in turn is based on utility; thus theirs was a utility theory of value, and, since utility is subjective rather than objective -- for

example, one person might prefer a power lawnmower while his neighbor prefers hiring someone to cut the grass -- their approach is regarded as subjective. Like the classical school, the marginalists reasoned abstractly and deductively. They hypothesized a state of pure competition, with many buyers and sellers, many homogeneous products, uniform prices, and no special influences on prices such as might be exerted by monopoly, advertising, etc. Such a market, they felt, tended toward a perfect equilibrium, so, like the classical economists, the marginalists believed that government should not interfere with markets. Finally, they assumed that economic man generally behaved rationally, minimizing pain and maximizing pleasure. The most important of the marginalists was Alfred Marshall. Others were W.S. Jevons, L. Walras, and C. Menger, who, working independently, arrived at the principle of marginal utility about the same time, and H.H. Gossen, F. von Wieser, E. Bohm-Bawerk, J.B. Clark, and A.C. Pigou.

Monopoly, Monopsony

Exclusive control over a particular product or service by one seller (monopolist) or one buyer (monopsonist). The terms also apply to groups of sellers or buyers who can exert such control through mutual agreement. The monopolist's essential advantage is the absence of competitors, enabling a firm to control the supply of its commodity so as to obtain the highest possible profit. Similarly, the monopsonist, as the only buyer, can control purchases so as to obtain the lowest possible price.

In practice monopoly is the more common of the two. A monopoly can be effective through control of less than 100 percent of output. For example, the American steel industry (technically an oligopoly) has monopolistic characteristics even though the largest producer accounts for less than one-third of the market. (In Great Britain, firms controlling 33.3 percent of the market are subject to investigation by the Monopolies Commission.) Monopoly has serious disadvantages for consumers besides high prices. It prevents resource allocation in accordance with consumer needs or choices, supply being controlled entirely for the monopolist's benefit. It affords no protection against inferior quality, and it removes any incentive for improvements other than those that increase the monopolist's profits. Consequently, private monopolies have been at least partially regulated and restricted in the United States since the late 19th century, and competition has been strongly encouraged. Nevertheless, monopolies or near monopolies based on patents, on scarce essential items, or on the availability of huge amounts of investment capital for certain industries all have counteracted competitive forces to the point where imperfect competition tends to prevail in most markets.

A public monopoly is an enterprise owned, operated, or strictly regulated by a government, such as a postal service, railroads, communications, lotteries, and public utilities. Some enterprises (such as telephone and postal services) can be most efficiently operated by single, large concerns, and it is obviously in the public interest that they be under some measure

of government control. A public monopoly may also be a means of raising revenue (lotteries) or an effective means of controlling a product that presents social problems (as with state monopolies over liquor sales in the United States, and government monopolies over tobacco products in many other countries). In such public enterprises the inherent evils of monopoly are at least restrained, if not eliminated entirely.

Productivity

In economic theory, the output of any factor of production -- land, labor or capital -- per unit of input. Productivity can be measured in various ways. The productivity of land may be measured, for example, in terms of output per acre. The productivity of labor is more likely to be measured in terms of output per working hour. The productivity of capital cannot be measured quite as easily, since it involves comparing physical output to the current real value of the capital invested in an enterprise and thus depends on such factors as level of technology, organization and management, and the type of capital employed (plant, machinery, etc.) It normally is expressed as a percentage per year, which represents the annual yield of that particular capital investment. Since capital goods tend to decline in value and eventually wear out, most economists distinguish between gross capital productivity (total yield) and net capital productivity, which discounts depreciation. The British economist J.M. Keynes called the latter marginal efficiency of capital (the expected yield of the last additional unit of capital, the term

used by many present-day economists, although some prefer marginal productivity of capital; the American economist Irving Fisher called it rate of return over cost. The concept is essentially the same, however, and it is important because of its close relation to the interest rate. Net capital productivity (or marginal efficiency) is the annual percentage yield earned by the capital, which is equivalent to the market rate of interest at which it would just pay to undertake a given investment. For example, if the market rate of interest is 8 percent, it obviously would not pay to invest in a project that yields only 7½ percent. The net productivity of capital itself influences the long-term interest rate. Like other economic phenomena, yield on capital is subject to the law of diminishing returns; when high-yield investments are exhausted, capital is used for lower-yield projects, and its net productivity will decline (described as declining marginal efficiency). The market rate of interest then will fall, encouraging more investors to undertake projects that previously were not profitable.

Profit

In economic theory, a surplus earned above the normal return on investment of capital in a business, created when the prices received for goods sold exceed the cost of producing them. Whereas economists of the classical school described profit as the entrepreneur's reward for risk-taking, many 19th-century economists, including Alfred Marshall, regarded profit as a kind of wage for able management. The American economist Frank

Hyneman Knight, in his Risk, Uncertainty, and Profit (1921), returned to the earlier idea, distinguishing between insurable risk (whose insurance premiums then become part of the cost of production) and uninsurable uncertainty. Profit then becomes a reward for guessing right on unpredictable changes in future demand and selling prices, and so is related not only to risk-taking but to the rate of economic change and the entrepreneur's business.

Welfare Economics

A branch of economics concerned with attaining various goals of social welfare through specific economic policies. These goals generally include the highest possible living standard for all individuals, a more equitable distribution of income (eliminating the extremes of rich and poor), and maximum freedom of economic choice. Welfare economists simply assume that these ends are universally desirable. Policies to achieve them might include heavy taxation of the rich, a special dole for the poor, and the elimination of monopolies. An economy that concentrates on the provision of social services to eliminate income differences is sometimes called a welfare state. One of the earliest proponents of welfare economics, which has as many opponents as supporters, was A.C. Pigou.

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